

Environmental effects-based concentrations have not been established for the surface and groundwater IHSs at the site. Therefore, WET testing of groundwater obtained from the site was conducted to determine TPH concentrations that are protective of aquatic organisms. WET-testing results are presented in Appendix K. The results concluded that a TPH concentration of 700 µg/L NWTPH-Dx is protective of fresh water organisms. Because the WET-testing measures toxicity associated with all constituents present in groundwater, TPH concentrations are used as a surrogate for all of the IHSs.

#### **5.2.4.3 Concentrations that Protect Organisms in Sediment**

Ecology has set forth a maximum permissible surface water TPH concentration that protects aquatic organisms in sediment (Ecology, 2004). This concentration is 208 µg/L NWTPH-Dx and VPH/EPH as discussed above in Section 5.2.2.2.

#### **5.2.4.4 Selected Surface Water Cleanup Level**

The most stringent of the human health and environmental effects-based criteria are selected as the cleanup level for each IHS (Table 5-1). For TPH, the most stringent criterion is based on protection of sediment. The PQLs for surface water are the same as reported for groundwater in Section 5.2.2.4. The manner in which PQLs and method detection limits will be handled during compliance monitoring has not yet been determined. Air

Ecology has set forth an air cleanup level of 1,246 µg/m<sup>3</sup> VPH/EPH based on the indoor air inhalation pathway (Ecology, 2004). This value was calculated using the four-phase model based on a hazard quotient of 1 and a soil concentration of 2,906 mg/kg VPH/EPH in accordance with WAC 173-340-750(3)(b)(ii)(C). Although the air cleanup level is based on indoor air inhalation assumptions, it will also apply to ambient air conditions.

### **5.3 Points of Compliance**

The points of compliance define the locations where the cleanup levels must be attained. The term includes both standard and conditional points of compliance. Points of compliance are established for each environmental medium in accordance with the requirements and procedures set forth in WAC 173-340-720 through 173-340-760. A conditional point of compliance is only available under certain conditions.

For the site, points of compliance for soil, groundwater, sediments, and surface water must be established and evaluated. The requirements pertinent to the establishment of those points of compliance are summarized below. The standard and conditional points of compliance considered in this FS are also summarized below.

### 5.3.1 Soil

The point of compliance for soil depends on the exposure pathway that the soil cleanup level is based on.

- **Direct Contact.** For soil cleanup levels based on direct contact, the point of compliance is defined as throughout the site from the ground surface to 15 feet below the ground surface.
- **Soil to Groundwater.** For soil cleanup levels based on protection of ground water, the point of compliance is defined as throughout the site. This means that the point of compliance extends throughout the soil profile and may extend below the water table.
- **Soil Protection of Vapor.** For soil cleanup levels based on protection from vapors, the point of compliance shall be established in the soils throughout the site from the ground surface to the uppermost ground water saturated zone (e.g., from the ground surface to the uppermost water table).
- **Protection of the Terrestrial Species.** For soil cleanup levels based on protection of the terrestrial species, the standard point of compliance is defined as throughout the site from the ground surface to 15 feet below the ground surface. For sites with institutional controls to prevent excavation of deeper soil, a conditional point of compliance may be set at the biologically active soil zone. This zone is assumed to extend to 6 feet. A different depth may be established based on site-specific information. Where a cleanup action involves containment of hazardous substances that exceed cleanup levels at the point of compliance, the cleanup action still complies with cleanup standards, provided the requirements specified in WAC 173-340-740(6)(f) are met.

### 5.3.2 Groundwater

Below, we discuss the standard point of compliance and the conditional point of compliance.

#### 5.3.2.1 Standard Point of Compliance

The standard point of compliance for ground water is throughout the site, from the uppermost level of the saturated zone, taking into consideration the seasonal groundwater fluctuations, and extending vertically to the lowest-most depth that could potentially be affected by the site (WAC 173-340-720(8)(b)).

For the site, a standard point of compliance is evaluated in Alternative “STD” of this Final FS.

### **5.3.2.2 Conditional Point of Compliance**

A conditional point of compliance may also be set for groundwater where it can be demonstrated that it is not practicable to meet the cleanup levels throughout the site within a reasonable restoration timeframe (WAC 173-340-720(8)(c)). Conditional points of compliance may either be set on the property or off the property that is the source of the contamination, subject to several conditions. Off-property points of compliance may be set off property in three specific situations, subject to several conditions specified in WAC 173-340-720(8)(d).

In this Final FS, an on-property conditional point of compliance is evaluated in Alternatives PB1 to 5 and an off-property conditional point of compliance is evaluated in Alternatives SW1 to 4. These conditional points of compliance are summarized below.

#### **On-Property Conditional Point of Compliance**

The on-property conditional point of compliance must be set as close as practicable to the source of the hazardous substances, but may not exceed the property boundary. The use of an on-property point of compliance is conditioned on the use of all practicable methods of treatment at the site (WAC 173-340-720(8)(c)). Alternatives PB1 to 5 consider an on-property conditional point of compliance. Each of those alternatives sets the point of compliance at the BNSF property boundary (the railyard).

#### **Off-Property Conditional Point of Compliance**

The definition of and the requirements for the off-property conditional point of compliance depend on the location of the BNSF property, which is the source of the contamination to the adjacent surface water. In this case, the BNSF property is located near, but does not abut, surface water. Consequently, the off-property conditional point of compliance must be set as close as practicable to the source of the releases that occurred on BNSF's property, but may not exceed the point where groundwater flows into the South Fork Skykomish River (WAC 173-340-720(8)(d)).

The establishment of such an off-property conditional point of compliance is conditioned on meeting several requirements, including, but not limited to the following (WAC 173-340-720(8)(d)(ii)):

- Groundwater discharges must be provided with all known available and reasonable treatment methods before being released into the South Fork Skykomish River
- Groundwater discharges must not result in violations of sediment quality values

- The affected property owners between BNSF's property boundary and the South Fork Skykomish River must agree in writing to setting such a conditional point of compliance.

Alternatives SW1 to 4 and BNSF's preferred alternative consider an off-property point of compliance located at the point of groundwater discharge to the South Fork Skykomish River and the former Maloney Creek channel.

### **5.3.3 Sediment**

The point of compliance is the biologically active zone consistent with WAC 173-760 and 173-204. Given that supplemental, site-specific information has not been obtained, the default point of compliance is the top 10 centimeters. Site-specific conditions, such as recontamination potential from subsurface sediments and/or groundwater, must also be considered in determining points of compliance.

### **5.3.4 Surface Water**

The standard point of compliance for surface water is the point at which hazardous substances are released to the surface waters of the state.

At the site, hazardous substances are released to the surface water as a result of groundwater flows. Therefore, the point of compliance must be established at the point at which hazardous substances are released to the surface waters. At the site, this point is where groundwater emanates from the sediment.

### **5.3.5 Air**

Cleanup levels developed under WAC 173-340-750 must be attained in the ambient and indoor air throughout the site.

## **5.4 Other Potentially Applicable Requirements**

MTCA requires that all cleanup actions comply with applicable state and federal laws (WAC 173-340-360(2)). MTCA defines applicable state and federal laws to include "legally applicable requirements" and "relevant and appropriate requirements." The information is presented in three tables (Table 5-2, Table 5-3, and Table 5-4) categorized as follows:

- Laws pertaining to establishment of cleanup levels
- Laws pertaining to treatment and disposal activities
- Laws that could affect planning or place restrictions on how cleanup actions may be performed.

The laws and regulations cited in this section pertain to non-hazardous wastes only as no "hazardous waste" exists at the site nor is the generation of any

hazardous waste anticipated as part of cleanup. Tables 5-2 through 5-4 do not refer to State Dangerous Waste Regulations (WAC 173-304) or Federal Resource Conservation and Recovery Act Subtitle C regulations (40 CFR 260-268) that regulate the management and disposal of “hazardous waste.”

## 6 Remediation Levels

This section develops and presents the rationale for remediation levels. WAC 174-340-200 defines “remediation level” as a concentration (or other method of identification) of a hazardous substance in soil, water, air, or sediment above which a particular cleanup action component will be required as part of a cleanup action at a site. Other methods of identification include physical appearance or location. A cleanup action selected in accordance with WAC 173-340-360 that includes remediation levels constitutes a cleanup action that is protective of human health and the environment. The remediation levels presented in this section are used in Section 7 to define the extent to which different components of a remedial alternative will be applied as part of an overall cleanup action that achieves cleanup standards.

### 6.1 Introduction

Remediation levels may be used at sites where a combination of cleanup action components are used to achieve cleanup levels at the point of compliance. Remediation levels may also be used at sites where the cleanup action involves the containment of soils. Remediation levels are not the same as cleanup levels. A cleanup level defines the concentration of hazardous substances above which a contaminated medium (e.g., soil) must be remediated in some manner (e.g., treatment, containment, institutional controls). A remediation level, on the other hand, defines the concentration (or other method of identification such as depth, location, etc.) of a hazardous substance in a particular medium above or below which a particular component of a cleanup action (e.g., soil excavation or containment) will be used. Remediation levels that are expressed as a concentration of a contaminant are, by definition, higher than cleanup levels.

The basis for remediation levels presented herein includes:

- Performance of soil and groundwater treatment systems
- Accessibility of contamination in relation to historical buildings and structures<sup>2</sup> Community disruption and related socioeconomic impacts
- Exposure pathways and risk to receptors.

Table 6-1 summarizes the proposed remediation levels.

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<sup>2</sup> A “building,” such as a house, barn, church, hotel, or similar construction, is created principally to shelter any form of human activity. The term “structure” is used to distinguish from buildings those functional constructions made usually for purposes other than creating human shelter. Examples of structures include bridges, fences, tunnels, railroad grades, trolley cars and earthwork (National Park Service, US Department of Interior, 1983).

## **6.2 Remediation Levels for Soil**

The most stringent soil cleanup level for TPH at this site is 22 mg/kg NWTPH-Dx and VPH/EPH as presented in Section 5. This cleanup level is based on protecting aquatic organisms in sediment from contaminated groundwater. All soil that exceeds 22 mg/kg NWTPH-Dx and VPH/EPH must be addressed by at least one component of the final cleanup action (which may include removal, treatment or containment beneath clean soils/structures and institutional controls). The only technology that can attain the soil cleanup level (22 mg/kg NWTPH-Dx and VPH/EPH) everywhere at the site with certainty is excavation, as included in the “STD” alternative described in Section 7. Much of the contamination underlies residential and commercial properties, infrastructure such as roads and utilities, and railroad tracks, and it is desirable to minimize the amount of disturbance in the town and the number of people, buildings, etc. that would need to be temporarily relocated. Also, many buildings in the residential and commercial district (the Developed Zones) are listed on the national and state Registers of Historic Places. Therefore, the majority of the other remedial alternatives developed in Section 7 and BNSF’s preferred alternative employ other, less invasive, technologies in combination with excavation to address different site cleanup zones in combination with containment and institutional controls to attain cleanup standards while minimizing disturbance to the town.

Site cleanup zones are defined in Section 7.3.1 to facilitate discussion of cleanup activities in various parts of the site. The cleanup zone terminology is used in this section to distinguish between remediation levels proposed for different portions of the site.

### **6.2.1 Remove Free Product**

A proposed remediation level is the removal of free product, as measured in monitor wells, using excavation. This remediation level is based on accessibility and community disruption issues. This remediation level is appropriate because it contributes to permanence and it is protective of human health and the environment.

#### **6.2.1.1 Accessibility**

The accessibility of free product for direct removal is limited by overlying permanent buildings, asphalt or concrete paving, a transcontinental railway and sensitive habitat (i.e., former Maloney Creek channel wetland). Many of the residential, commercial and public buildings in Skykomish are listed on the national and state Registers of Historic Places (see Section 2.3.1). Although it may be technically possible to temporarily relocate structures and buildings to allow access to underlying soils, it is very disruptive to residents, businesses and the school, and there is the risk of damage to historically

significant buildings.<sup>3</sup> Similarly, disruption of railroad operations to access soils beneath the rail line is prohibitively costly and disruptive to railroad customers. Access to soils underlying the former Maloney Creek channel is limited because destruction of mature vegetation and ecological habitat would be required. Although habitat can be reconstructed and damage mitigated, it will take many years to restore or mitigate the habitat damaged by cleanup activities.

### **6.2.1.2 Technical Approach**

Excavation is the most certain means to remove free product from the subsurface. Excavation is best-suited to areas where free product is accessible without disturbing a structure or building and areas where the presence of free product would result in groundwater exceeding the cleanup levels at the alternate point of compliance (Skykomish River). Excavation can also be used in areas where the number of buildings to be temporarily located is small relative to the amount of free product present and where the buildings to be relocated are not historically significant.

Where accessibility is an issue, recovery trenches are the proposed remedial technology for recovery and containment of free product. Recovery trenches are a component of several of the remedial alternatives developed in Section 7 and BNSF's preferred alternative (Section 10). They are targeted for use primarily in the NW Developed Zone due to the type of contaminant present, the density of residential and commercial buildings and their historical significance and the low potential for exposure to contamination, and in the Railyard since much of the free product lies beneath the railroad tracks.

### **6.2.1.3 Protectiveness**

The removal of free product helps satisfy the MTCA requirement to remove NAPL and it contributes to the protectiveness of a remedy in three ways.

First, the removal of free product is the most cost-effective means of reducing the mass of petroleum at the site, thereby contributing significantly to permanence. Soil in free product areas contains the greatest petroleum mass per unit of soil volume. As a result, excavation focuses on areas where the greatest contribution to permanence or mass removal of a remedy can be achieved.

Second, the removal of free product will contribute to the effectiveness of less intrusive remedies such as enhanced bioremediation. The presence of free product hinders the performance of in situ technologies such as enhanced

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<sup>3</sup> Note, according to the U.S. Department of the Interior Standards for the Treatment of Historic Properties, buildings should be returned to their original sites or new sites in such a way that the rail-oriented configuration of lots and buildings, streetscape and siting of buildings relative to the street are maintained as much as possible. This is part of the character of the town and the setting for the historical district.

bioremediation. The mass of petroleum associated with free product contributes to an extended restoration timeframe when using enhanced bioremediation. The presence and behavior of free product hinders the bioavailability of petroleum constituents and can contribute to both an increased restoration timeframe and a higher treatment endpoint.

Third, the removal of free product will achieve groundwater concentrations protective of human health. The removal of free product reduces groundwater concentrations to levels protective of human health. Empirical data that were presented in Figure 3-9 demonstrate that exceedances of the groundwater concentration protective of human health (477 µg/L total VPH/EPH) are closely associated with free product. This is consistent with the Concise Explanatory Statement of MTCA where it states, “an infinite amount of diesel fuel can be left in the soil without causing ground water impacts” in reference to a diesel fuel without benzene. The Concise Explanatory Statement also noted that “diesel fuel would be a reasonable conservative approach to heavy oils” since diesel fuel has light aromatics but heavy oil has carcinogenic PAHs. This is also consistent with the leaching test results (see Appendix L), which demonstrated that TPH in the soil at the site does not present an unacceptable carcinogenic or non-carcinogenic risk to drinking groundwater, except where free product (defined in MTCA as “a distinct separate layer” of oil) is present. As a result, the removal of free product results in groundwater concentrations protective of human health. Using this remediation level, further treatment would be required prior to discharge to the Skykomish River to achieve the 208 µg/L NWTPH-Dx and VPH/EPH cleanup level protective of sediment.

## **6.2.2 Excavate Free Product Where Accessible**

The concept of accessibility is further incorporated as a remediation level in some of the cleanup alternatives developed in Section 7 to limit the disturbance of structures, buildings, habitat, etc. as much as possible, while satisfying threshold requirements. The remediation level that is used is “excavate free product where accessible.” This approach eliminates direct conflict between remedial actions and buildings or structures by excavating free product only in those areas that are accessible without physically moving a building or structure. This remediation level incorporates the certainty of excavation of free product while considering accessibility and community impacts.

Examples of this remediation level include Alternatives SW3 and PB1, which call for excavation of free product in the NW Developed Zone “where accessible.” In the former Maloney Creek channel, limiting disruption of habitat is the rationale for incorporating hot-spot removal (free product removal) as a remediation level in Alternatives SW4 and PB3.

This remediation level decreases the risks associated with the direct contact pathway since free product remains only in those areas where the subsurface impacts cannot be physically accessed without significant effort. At some point in the future, if a structure or building is moved, the free product becomes accessible and may be excavated. Since there is some free product left in place, alternatives that use this remediation level will have a more difficult time achieving the groundwater level protective of human health (477 µg/L total EPH/VPH) and the groundwater cleanup level. There will also be the potential for free product to migrate from beneath structures and buildings and recontaminate areas that were already excavated unless physical containment barriers, such as recovery trenches, are used. Excavation of free product where accessible will be complicated by the presence of structures and buildings that will require the use of shoring or sloping, and the use of sloping will reduce the amount of petroleum mass that can be removed.

### **6.2.3 Remove/Treat Soil to 20,000 mg/kg NWTPH-Dx**

This remediation level is included in the FS as an example of a soil remediation level between removal of free product and achieving the cleanup level. This remediation level is incorporated into remedial alternative PB4 to provide another data point by which to compare alternatives in Sections 9 and 10, specifically in the substantial and disproportionate costs analysis. It is this analysis of the remedial alternatives where the appropriate choice between remediation levels and cleanup levels is achieved.

The use of the 20,000 mg/kg NWTPH-Dx level increases the protectiveness of groundwater for human health. This remediation level does increase the permanence of the remedy and it also increases the certainty that enhanced bioremediation will achieve the groundwater cleanup level of 208 µg/L NWTPH-Dx (diesel plus motor oil) prior to discharge to the river. The evaluation of remedial alternatives will assess whether this increased certainty is cost-effective and the SEPA analysis associated with the Cleanup Action Plan will determine whether the impacts to the built and natural environment are acceptable.

### **6.2.4 Remove Soil to 2,000 mg/kg NWTPH-Dx**

Alternative PB5, included at Ecology's request, consists of excavation of soil in all of the site cleanup zones to 2,000 mg/kg NWTPH-Dx. This remediation level falls between the soil cleanup level needed to protect organisms in sediment (22 mg/kg NWTWPH-Dx and VPH/EPH) and the direct contact cleanup level (2,130 and 2,765 mg/kg VPH/EPH for vadose and smear zone soils, respectively). This remediation level is equal to MTCA's default residual saturation for diesel, and therefore is protective of groundwater.

## 6.2.5 Direct Contact (Human)

Remediation levels proposed for protection of human direct contact with soils and airborne contaminants are based on concentration, depth, land use and location. These remediation levels are necessary when the proposed remedy to achieve the cleanup standard uses containment and institutional controls or when the cleanup action does not completely address all of the potential exposure pathways at all locations.

### 6.2.5.1 Developed Zones

Contamination in the Developed Zones consists of petroleum in smear zone soil and groundwater and as free product in the smear zone and discontinuous contamination of surface soil with lead. All of the remedial alternatives (Section 7) include excavation of accessible, near surface metals in the Developed Zones to a depth of two feet bgs. This soil zone has a high likelihood of disturbance, and therefore potential for exposure, resulting from typical residential activities including, but not limited to:

- Mowing, raking, sweeping
- Children/pets digging
- Gardening
- Tree planting
- Re-sodding
- Irrigation system installation
- Paving/install sidewalk
- General landscaping
- Deck foundation.

Additionally, alternatives SW4, PB3, and PB4 offer additional protection to residents by achieving direct contact cleanup levels for smear zone soil in the upper four feet of soil in the NW Developed Zone. The smear zone direct contact cleanup level is 2,765 mg/kg VPH/EPH or 3,400 mg/kg NWTPH-Dx<sup>4</sup>. The smear zone direct contact cleanup level is used as a remediation level because TPH impacts in the NW Developed Zone are limited to the smear zone and are the result of free product migration and groundwater transport.

### 6.2.5.2 Railyard

Contamination in the Railyard Zone consists primarily of lead and arsenic in the surface soil, petroleum hydrocarbons in vadose and smear zone soil, groundwater contamination in the smear zone, and free product. All of the remedial alternatives in Section 7 remove near surface metals-impacted soils from the upper two feet of soil and backfill the excavation with a clean fill cap. This two-foot depth remediation level eliminates the airborne particulate

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<sup>4</sup> Calculated by multiplying by 1.25 factor developed through correlation of NWTPH-Dx and VPH/EPH soil data, as presented in Section 3.

exposure pathway and protects against direct contact exposure by trespassers in accessible areas. Alternatives SW4, PB3, PB4, STD and BNSF's preferred alternative also include excavation of near surface TPH-impacted soils to the vadose zone direct contact cleanup level of 2,130 mg/kg VPH/EPH or 2,600 mg/kg NWTPH-Dx<sup>5</sup> in the upper two feet of soil.

BNSF considers a two-foot depth remediation level appropriate because exposure to subsurface contamination on the railyard can successfully be prevented using institutional controls with a high degree of assurance. For example, railroad employees routinely receive health and safety training as required by WISHA, OSHA and the FRC. Operational procedures can be developed to ensure workers are properly trained, or are required to bring in properly trained individuals to conduct any track maintenance work that requires disturbance of soil to depths greater than two feet bgs.

### **6.2.5.3 Levee**

Several of the alternatives (SW4, PB3, PB4 and BNSF's preferred alternative) include excavation of the levee to the smear zone direct contact level of 3,400 mg/kg NWTPH-Dx. Since soil impacts in the levee are found in the smear zone, and not the vadose zone, this remediation level is also protective of the direct contact pathway. Removal to this concentration is greater than that needed to protect the river (i.e., excavation area extends beyond area identified with biological impacts to sediments) and to satisfy the groundwater cleanup level, as shown in Figure 6-1.

## **6.2.6 Terrestrial Ecological Exposure**

As discussed in Section 5 and Appendix D, the TPH cleanup level based on protection of terrestrial ecological exposure to soil biota in areas other than the railyard zone is 1,870 mg/kg NWTPH-Dx. The conditional point of compliance for this exposure pathway specified by MTCA is 6 feet bgs, based on a generic estimate of the biologically active zone. At Skykomish, the upper 12 inches, or one foot, of soil is a reasonable estimate of the soil zone depth where the majority of biological activity occurs (i.e., soil mixing by earthworms, moles, ants, etc.) (Ecology, 1999; Sutter, 2000; TEE, Appendix D). A remediation level depth of one foot bgs for removal of soil in the accessible areas of the developed zones, as well as the former Maloney Creek channel, where the TEE cleanup level is exceeded will protect terrestrial species when combined with clean soil backfill and institutional controls and monitoring.

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<sup>5</sup> Calculated by multiplying by 1.25 factor developed through correlation of NWTPH-Dx and VPH/EPH soil data, as presented in Section 3.

### **6.2.7 Soil to Air**

A soil cleanup level of 2,900 mg/kg VPH/EPH is established in Section 5 based on protection of the indoor air pathway. This cleanup level applies to the developed areas of the site, since these are the areas with unrestricted land use and where residential/commercial buildings overlie the contamination. This level serves as a remediation level beneath buildings in the Developed Zones where the remedial alternative results in remaining soil concentrations that exceed 2,900 mg/kg VPH/EPH. When this level is exceeded beneath a building, it will trigger cleanup action components that address the soil to vapor pathway. These cleanup action components may consist of monitoring, vapor barriers or venting, for example.

## 7 Development of Remedial Alternatives

This section describes the remedial alternatives that can meet the cleanup standards presented in Section 5 and remediation levels in Section 6. To develop remedial alternatives, individual cleanup technologies were first screened to identify technologies that are implementable and effective at the site. This screening is described in detail in Appendix M and summarized in Section 7.1.

Using the results of the technology screening, technologies that are implementable and effective at the site were grouped into remedial alternatives. Section 7.3 describes the approach used to group individual cleanup technologies and develop the resulting remedial alternatives presented in Section 7.4.

In Section 7.4, the remedial alternatives for the site are described. Section 7.4.1 summarizes how each technology (regardless of alternative) would be implemented at the site. Section 7.4.2 summarizes each alternative.

### 7.1 Technology Screening

This section summarizes the results of the screening process for individual cleanup technologies that should be suitable for cleaning up contaminated soil, groundwater at the site. Technologies suitable for cleaning up sediment are included with the discussions about contaminated soil. Surface water cleanup was not considered separately in this screening evaluation because cleanup actions designed for sediments, soil and groundwater must also protect surface water. A detailed description of the screening process is presented in Appendix M.

Table 7-1 identifies the cleanup technologies screened and determined to be effective and implementable or to hold promise of being effective and implementable in the context of physical and chemical conditions at the site. In Section 7.4, these technologies are grouped into remedial alternatives that address all of the contamination at the site.

#### 7.1.1 Metals in Soil

For metals in soil, the technology screening determined that appropriate response actions were containment or removal. Containment would be achieved by capping while removal would be achieved by excavation. If metals-impacted soils were removed they would either have to be treated *ex situ* or disposed of. *Ex situ* technologies retained for further consideration are soil stabilization and cement incorporation. The only disposal option considered, placing the material in a commercial landfill, was retained.

### 7.1.2 Petroleum Hydrocarbons in Soil

In addition to containment and removal, *in situ* treatment technologies were retained for petroleum hydrocarbons in soil. As with metals in soil, containment would be achieved by capping and removal would be by excavation. *In situ* treatment would be achieved through bioventing. Excavated soils could be treated *ex situ* by thermal desorption or cement incorporation. Disposal for excavated petroleum impacted soils would be by placing the materials in a commercial landfill.

### 7.1.3 LNAPL

Technologies retained for further consideration that address LNAPL contain, extract, treat *in situ*, or reuse the LNAPL. Containment would be attained by placement of a slurry wall or permeation grouting. LNAPL extraction technologies that have been retained are excavation, skimming, and recover trenches. Removed LNAPL could then be reused by recycling as an off-specification fuel. Alternatively, LNAPL could be treated *in situ* by flushing (*in situ* or hot water/steam) or by *in situ* oxidation.

### 7.1.4 Dissolved Petroleum Hydrocarbons in Groundwater

Dissolved petroleum hydrocarbons in groundwater could be treated by containment, extraction (and *ex situ* treatment or discharge), or *in situ* treatment. Containment could be achieved through the use of a slurry wall and extraction could be achieved through pumping. Once extracted the water could be treated *ex situ* with bioreactors, by phase separation, precipitation, filtration, carbon adsorption, or oxidation. Once treated the water could be discharged under an NPDES permit or re-injected into the subsurface. The *in situ* technologies retained for further consideration are enhanced aerobic biodegradation, chemical oxidation, and natural attenuation.

## 7.2 Bench-Scale Testing of Cleanup Technologies

Few *in situ* cleanup technologies are considered potentially effective for contaminants identified at the site and limited performance data are available for these technologies and contaminants. To determine the potential effectiveness of these technologies, bench-scale testing was performed for the following cleanup technologies:

- *In situ* flushing using hot water mixed with surfactant and polymer
- *In situ* biological treatment
- *In situ* chemical oxidation using ozone.

The scope of this testing was described in the *Bench Testing Work Plan* (RETEC, 2003e). This testing commenced in May 2003 and complete results are provided in the *Bench-Scale Cleanup Technology Testing Report* (RETEC, July 1, 2004). The tests were designed to measure the potential effectiveness of these three technologies at this site. *Ex situ* technologies (e.g., excavation) do not require bench scale testing to determine their potential effectiveness.

The following subsections provide summaries and excerpts from the Bench-Scale Cleanup Testing Report on the application of the three *in situ* technologies in light of the treatability data. A full analysis and all analytical data referenced appear in the Bench-Scale Testing Report (RETEC, July 1, 2004).

### **7.2.1 Results for Flushing with Surfactant and Polymer**

Surfactant flushing was relatively successful at removing petroleum from the soil columns, while the combination of surfactant flushing and biopolishing was more successful. The combination of technologies achieved soil cleanup levels for direct contact (2,130 mg/kg EPH/VPH) developed by Ecology but was above the soil cleanup level for protection of groundwater (22 mg/kg NWTPH-Dx and EPH/VPH) developed by Ecology. The final EPH/VPH concentrations were 163 mg/kg in SP1 and 255 mg/kg in SP5.

These surfactant flushing tests were performed at temperatures of 60°C, which is achievable in the field only by using a combination of heating techniques, such as hot water injection and electrical resistance heating. As such, this approach would not be cost-effective. However, due to the positive results of the test, it was believed that successful removal of petroleum may occur at lower temperatures (e.g. ~ 45 °C). In addition, the success of the biopolishing portion of the test suggested that surfactant-enhanced bioremediation showed promise as a cost-effective technology for the site.

The Draft Final FS (RETEC, 2004) considered surfactant enhanced flushing to be an appropriate technology for application at the site. However, after additional evaluation, BNSF has determined that the surfactant enhanced flushing technology is not sufficiently developed and proven to reliably recover the type of highly viscous LNAPL found at this Site. Other site-specific factors that limit the viability and effectiveness of the technology are the shallow depth of groundwater and the permeability of the vadose and smear zone soil.

BNSF believes that while surfactant-enhanced flushing appears to have potential as an effective, *in situ* technology for remediating poorly accessible areas, the technology is not currently developed to a point for use within the challenging operational constraints at Skykomish, and carries a high risk of not achieving performance objectives. Shallow groundwater and high

LNAPL viscosity may severely limit the ability of the technology to achieve Ecology, BNSF and the community expectations. Bench testing has shown that even under idealized conditions, achieving numeric cleanup levels is unlikely and there are no existing pilots or full-scale testing at other similarly sites to suggest that a more limited objective of removing mobile LNAPL with certainty.

## **7.2.2 Results for Biological Treatment**

A full range of biological treatment studies was conducted for two soil samples. One sample was collected from the NE Developed Zone where diesel is the primary petroleum compound and the second sample was collected from the NW Developed Zone where bunker C and diesel are present (zones are defined in Section 7.6.4 of this FS). The results for the NW Developed Zone are considered representative of the Former Maloney Creek Zone. Limited testing was also performed for a soil sample collected from the far east end of the Railyard.

### **7.2.2.1 NE Developed Zone**

Significant reductions in petroleum levels were noted during biodegradation testing for soil from the NE Developed Zone. The final concentrations were well below direct contact cleanup levels for both the nutrient-amended and the unamended flasks.

The final EPH/VPH soil concentrations from the nutrient-amended flasks were evaluated for protection of groundwater using the 4-phase model. These were the only EPH/VPH data available even though the unamended flasks performed better according to the NWTPH-Dx data. In accordance with WAC-173-340-720(9)(e)(v), those substances or fractions that have not been detected in soil in the NE Developed Zone or on the Railyard in the vicinity of the NE Developed Zone were excluded from the analysis.

Using half of the detection limits for the other undetected samples results in a HI of 1.5 for the nutrient-amended sample and 1.38 for the nutrient-amended duplicate sample. These results are above the cleanup level HI of 1, but the vast majority of the risk (0.92 of the HI) is based on half of the detection limit for the following petroleum ranges: aromatic EC >8-10 range and aromatic EC>10-12. These ranges are highly amenable to biodegradation suggesting that half of the detection limit is an unreasonable assumption. In total, only 0.37 to 0.42 of the HI is based on detected concentrations.

Based on these data and past experience, an appropriate compliance monitoring program will demonstrate that enhanced bioremediation will achieve groundwater cleanup levels in the NE Developed Zone. BNSF proposes to use the empirical demonstration (WAC 173-340-747(9)) to demonstrate compliance with soil concentrations protective of groundwater.

### **7.2.2.2 Former Maloney Creek Zone**

Bioremediation is also being considered for the Former Maloney Creek Zone. Biodegradation performance is assumed to be similar to the MW-45 biodegradation testing due to the similar petroleum composition. Using the MW-45 treated soil data, soil concentrations protective of groundwater can be achieved through bioremediation alone. Based on a review of data on Figures 3-4 and 3-11 of the Draft FS/EIS (RETEC, 2003), location 2A-B-8 is the only sample in the vicinity of the Former Maloney Creek Zone that exceeds the initial diesel concentration in MW-45. These results suggest that a hot spot removal near 2A-B-8 followed by enhanced bioremediation is likely to satisfy Method B groundwater criteria and prevent significant disruption to the wetland.

### **7.2.2.3 NW Developed Zone**

The use of biodegradation as a standalone cleanup approach was considered potentially viable for areas of the NW Developed Zone where free product was not present. Due to the high initial concentration, the sample from the NW Developed Zone did not achieve cleanup levels. However, if we apply the removal rates achieved in this biodegradation test for the EPH/VPH ranges, the 4-phase model indicates that the direct contact cleanup level for unrestricted land use can be achieved for initial soil concentrations below about 7,000 mg/kg diesel-range hydrocarbons according to the initial sample ratios between analyses (see Table 2-2 data). Based on Figures 3-4 and 7-2, only four soil samples outside of the defined free product areas exceed this concentration in the NW Developed Zone (5-W-4, 1A-W-3, 2A-W-1, and 2A-W-2), and these samples are all within 70 feet of the edge of a free product plume. These data indicate that direct contact cleanup levels for soil (2,130 mg/kg TPH) are achievable throughout the NW Developed Zone when enhanced bioremediation is used in conjunction with free product removal.

## **7.2.3 Summary of Bench-Scale Results for Chemical Oxidation with Ozone**

Chemical oxidation with ozone was considered as an option for soil and groundwater treatment in the Levee that would minimize short-term impacts to the Skykomish River. Treatment with ozone showed some promise at removing petroleum impacts from the subsurface. The doses and durations used in the bench test were selected to be cost competitive with excavation. While these doses and durations were effective at reducing the total EPH/VPH concentrations they did not achieve cleanup levels. Since this test was not successful, it does not appear cost-effective to use ozone. Excavation of the Levee will provide immediate and complete removal of petroleum impacts and will allow achievement of groundwater levels protective of sediment.

## 7.3 Approach to Developing Remedial Alternatives

This section describes the approach used to develop site-wide remedial alternatives, using the individual cleanup technologies discussed in Section 7.1 and the cleanup levels discussed in Section 5. The remedial alternatives are described in Section 7.4.3 and evaluated in detail in Section 8. The approach to developing the suite of remedial alternatives presented herein was performed in phases, as described below:

- Subdivide the site into “cleanup zones” based on exposure pathways, land use, and distribution and chemical composition of hazardous substances (Section 7.3.1)
- Consider standard and conditional POCs for each affected media (Section 7.3.2)
- Consider soil remediation levels based on exposure pathways (Section 6)
- Combine individual cleanup technologies from Section 7.1 into a suite of remedial alternatives that meets cleanup standards (i.e., cleanup levels at various POCs) and remediation levels.

Each of these phases is described in more detail below. The resulting remedial alternatives are presented in Section 7.4.

### 7.3.1 Site Cleanup Zones

The concept of site cleanup zones was developed to facilitate the evaluation of remedial alternatives. The zones are based on exposure pathways, land use, and distribution and chemical composition of hazardous substances at different parts of the site. The zones are defined as follows:

- 1) **Aquatic Resource Zones** – The South Fork Skykomish River and Levee and the former Maloney Creek channel (and associated wetland) are considered Aquatic Resource Zones due to the potential for ecological and recreational exposures, the presence of contaminated groundwater that affects sediment and surface water, and the lack of potential future development, such as housing. The Aquatic Resource Zones are noted in the orange hatching on Figure 7-1.
- 2) **Developed Zones** – The Developed Zones have been or are likely to be developed for residences, commercial buildings, streets, and public institutions, such as the school, city hall, and community center. These zones are primarily affected by petroleum contaminants in the groundwater and surrounding subsurface soil.

Three Developed Zones were defined based on location and the different types of petroleum affecting the zones: the Northwest (NW) Developed Zone, the South Developed Zone, and the NE (NE) Developed Zone (Figure 7-1). The NW Developed Zone and the South Developed Zone are affected by petroleum plumes that consist of a mixture of diesel and bunker C and are separated by the Railyard Zone. These two developed zones are noted in the pink hatching pattern on Figure 7-1. The NE Developed Zone is affected by a petroleum plume primarily composed of diesel fuel. Smear zone soil data from 1B-W-1, 1C-W-1, and 2A-W-6 indicate that 85 percent to 90 percent of the petroleum present in this Zone is in the diesel range. The greater diesel content in the NE Developed Zone indicates that petroleum in this Zone is more soluble and more biodegradable than the petroleum present in the NW and South Developed Zones. Therefore, different cleanup technologies may be applied to the NE Developed Zone than the NW and South Developed Zones. The NE Developed Zone is noted in purple hatching on Figure 7-1.

- 3) **Railyard Zone** – The Railyard Zone has historically been used for industrial purposes and should continue as an industrial site for the foreseeable future. It includes BNSF property with surface and subsurface soil impacts. It also includes small areas immediately adjacent to the BNSF property: two with surface soil metal impacts, and one with surface and subsurface soil TPH impacts. The Railyard Zone is noted in blue hatching on Figure 7-1.

Figure 7-1 provides a clear representation of the locations of these zones. Figure 7-2 illustrates the basis for the areal extent of these zones by overlaying all known and suspected areas of soil, groundwater, and sediment impacts. The extent of TPH soil impacts illustrated on Figure 7-2 is based on the 20 mg/kg TPH-diesel contour for surface, vadose, and smear zone soil impacts. This contour was used to represent the maximum extent of impacts exceeding cleanup levels for purposes of the FS as it closely approximates the areas that exceed the cleanup level for all TPH.

### 7.3.2 Points of Compliance

Section 5.3 presents the standard and conditional POCs used to develop and evaluate the remedial alternatives. The POCs are the locations where cleanup levels would be achieved and are considered part of the cleanup standards and are summarized in Table 7-2. Site-wide remedial alternatives were developed to meet cleanup standards for the following three POCs: (1) off-property, conditional groundwater POC at the points of discharge to surface water (SW1 to SW4); (2) on-property, conditional groundwater POC at the property boundary (PB1 to PB5); and (3) the standard POCs (STD).

## **7.4 Description of Remedial Alternatives**

The approach outlined in Section 7.3 is used in this section to develop a suite of remedial alternatives. Individual cleanup technologies were first selected for each cleanup zone based on the nature and extent of contamination, land use and exposure pathways. The technologies selected for each cleanup zone are described in Section 7.4.1.6. Institutional controls are applicable to some extent in all cleanup zones; therefore, they are discussed in context of all cleanup zones in Section 7.4.1.7.

After grouping technologies by cleanup zone, they were grouped based on their ability to comply with cleanup standards and attain remediation levels. As described in Section 5, compliance with cleanup standards includes attaining the cleanup levels at specific POCs. Soil, sediment and surface water POCs are the same for all alternatives. However, the standard and two conditional POCs for groundwater (defined in Section 5.3) were used to develop the remedial alternatives. The groundwater POCs were used to name the alternatives in Section 7.4.2.

In addition to meeting cleanup levels at the POCs, alternatives were selected based on achieving remediation levels (Table 7-3). Remediation levels mostly apply to soil and sediment cleanup; however, a remediation level for free product removal from groundwater is also included. All alternatives meet the remediation levels, as explained in Section 7.4.2, in addition to meeting the cleanup levels at the POCs.

### **7.4.1 Detailed Description of Remedial Approaches by Cleanup Zone**

The site-wide remedial alternatives presented in Section 7.4.2 use different combinations of cleanup technologies within each cleanup zone, as illustrated in Table 7-4. To limit repetitious text, all cleanup technologies applicable to each cleanup zone are described separately, by cleanup zone, in the following six subsections (as listed on Table 7.4).

For example, the technologies for cleaning up the South Developed Zone include natural attenuation and excavating free product and TPH in the surface soil and the smear zone. Some site-wide remedial alternatives use all of these technologies, whereas others use only a few of the technologies (Table 7-4). The following five subsections demonstrate how each cleanup technology would be implemented in each cleanup zone and describe all remedial approaches. Section 7.4.2 describes how the remedial alternatives combine these different cleanup technologies in a way that meets site-wide cleanup standards and remediation levels.

#### **7.4.1.1 Levee and South Fork Skykomish River Aquatic Resource Zone**

This zone incorporates the area downgradient of the existing barrier wall and the locations of petroleum impacts to the bank and sediment of the South Fork Skykomish River. The majority of this zone includes the floodwater control levee that was designed by the USACE in 1951 and is currently managed by the King County Department of Natural Resources, Rivers Section.

The cleanup technologies for this zone include:

- Removing surface sediment
- Enhanced bioremediation
- Excavation.

These technologies are described in the following subsections. All activities on the levee would be coordinated with King County, which manages the levee for purposes of local water control.

##### **Remove Surface Sediment**

This technology involves the excavation of the upper 4 inches (10 centimeters) of sediment to achieve cleanup levels in the biologically active zone. It is estimated that an area about 725 feet long and 20 feet wide exceeds the cleanup level (Figure 7-3). Including overexcavation to a depth of 1 foot, 540 cubic yards (cy) of sediment is expected to be removed. Surface sediment removal would not occur until soil and groundwater impacts within the levee have been addressed. Sediment removal activities would be designed to comply with ARARs, such as Ecology's water quality standards (including anti-degradation) and the Federal Clean Water Act and Endangered Species Act.

Two of the site-wide remedial alternatives (SW3 and PB2) include excavation of free product from within the levee. For these alternatives, removal of surface sediment would be limited to the free product seep areas since this is where bioassay failures occurred. These alternatives minimize disruption to the shoreline habitat. This sediment removal area is about half the area that exceeds cleanup levels for an excavation volume of 270 cy.

A temporary cofferdam or deflector will be placed in the river to keep surface water away from the sediment excavation. An access ramp to allow dam placement and excavation will be created by removing about 6 feet of clean fill from the top of the levee in a 50-foot-wide area near the east end of the levee. Excavation would be performed using a track-mounted excavator. Difficulties are to be expected due to the presence of cobbles and boulders. Excavated sediment will be immediately removed from the river channel via an off-road dump truck to a stockpile area on the railyard. The excavation will be backfilled with coarse-grained soil, similar to what was excavated.

This work would be performed in late summer during low water conditions to minimize impacts on water and protected fish species. The construction window for the South Fork of the Skykomish River and its tributaries between Sunset Falls and Alpine Falls would allow in-water cleanup activities to occur between July 1<sup>st</sup> and August 31<sup>st</sup> (WDFW, pers. comm., 2003c). This construction window may be extended based on site-specific permitting.

### **Enhanced Bioremediation**

Enhanced bioremediation is not an effective cleanup technology by itself in the Levee Zone due to the presence of bunker C/diesel free product and significant soil impacts. The purpose of this technology is to address dissolved-phase groundwater impacts that could continue to migrate through the levee under some of the site-wide alternatives due to the presence of free product or significant soil impacts in the Levee Zone or the NW Developed Zone. Bench-scale testing of this technology has been performed and is described in detail in the Bench-Scale Cleanup Technology Testing Report (RETEC, 2004), and in Section 7.2 of this FS. This testing provides information about potential treatment endpoints that can be achieved with this technology.

Enhanced bioremediation will be implemented using air-sparging techniques. A single row of air sparging wells will be installed across the area that exceeds the groundwater cleanup level of 208 µg/L. These wells will be installed through the top of the levee and, as a result, will require that the levee be cleared of brush and trees (Figure 7-4). Aboveground power lines along West River Road will be shielded, as necessary, during drilling and trenching activities. Wells will be installed at 25-foot spacing, with the top of the well screen 10 feet below the low water table elevation, and air will be injected at a rate of 2 to 3 standard cubic feet per minute (scfm) per well. Compressed air will be supplied using positive displacement blowers located in the vicinity of the levee. These blowers will be contained in insulated sound enclosures to reduce noise impacts. Compressed air piping will be placed in a trench on top of the levee.

### **Excavation**

Excavation includes the removal of free product or contaminated soil from between the existing barrier wall and surface sediment in the South Fork Skykomish River (Figure 7-5). All brush on the levee will be removed prior to excavation. A temporary cofferdam or deflector will be placed in the river to keep soil and contamination away from surface water. Power poles and lines along West River Road and the levee will be temporarily relocated during construction activities. Access for dam construction and clearing will be created by cutting an entry in the east side of the levee, as described for surface sediment excavation and by creating a ramp on the west end of the levee. A temporary road will have to be constructed west of the schoolyard to allow traffic to circulate and to provide emergency access to residences on the

west end of West River Road. The abandoned residence on West River Road (the second residence east of the school yard) could be demolished so that a road might be constructed to connect Railroad Avenue to West River Road. If this is not possible, an alternate means of access to the west end of West River Road will need to be established, or the residents may need to be vacated during excavation activities.

The excavation will start on the east end of the levee, closest to the bridge. Clean soil will be excavated from the top of the levee and placed in trucks for temporary stockpiling on the railyard. Impacted soil will then be loaded into trucks for temporary stockpiling prior to treatment or disposal. As the excavation proceeds to the west, clean overburden soil might be immediately placed as backfill in previously excavated areas.

Streets and aboveground utilities will be returned to their current or historic character after disturbance, while restoring the same dimensions and materials above ground. The final design will be a result of discussion and planning with the Town of Skykomish. The Secretary of the Interior's Standards for the Treatment of Historic Properties do not 'apply' to the cleanup action because there is no grant-in-aid involved (see 36 CFR Part 68) but the Standards are 'relevant and appropriate' under MTCA to the extent the cleanup will affect historic buildings, sites, structures or districts.

The free product excavation is estimated to be 9,380 cy, with 4,870 cy requiring treatment or disposal. Excavation to 3,400 mg/kg NWTPH-Dx would generate 29,690 cy of soil with 15,990 cy requiring treatment or disposal while excavation to 2,000 mg/kg NWTPH-Dx would generate 32,480 cy of soil with 17,200 cy requiring treatment or disposal. Excavation to the cleanup level would generate 39,610 cy of soil, with 20,630 cy requiring treatment or disposal.

For all site-wide alternatives except SW1, SW2, and PB1, the barrier would be excavated since excavation of free product would occur in both the Levee and NW Developed Zones.

Excavation would be performed in late summer during low water conditions to prevent discharges to surface water and to satisfy the "fish window" that is intended to protect threatened species. The "fish window" for the South Fork of the Skykomish River and its tributaries between Sunset Falls and Alpine Falls is July 1<sup>st</sup> through September 15<sup>th</sup>. It is assumed that some water in the excavation will be managed to remove any free product that accumulates and to allow collection of excavation verification samples from the bottom of the excavation. Soil confirmation sample analysis will be performed with an on-site laboratory or using 48-hour turnaround at a fixed facility.

#### **7.4.1.2 Former Maloney Creek Aquatic Resource Zone**

This zone includes the ditch and wetland areas located north of the Old Cascade Highway, and is associated with storm drainage through the former Maloney Creek channel. The zone also includes any surface sediment impacted areas between the culvert and Maloney Creek on the south side of the Old Cascade Highway. This zone is considered separately due to the potential for groundwater discharge to surface water during high water events and due to the presence of a wetland. In addition, Coho salmon, a threatened species, have been noted in this storm water drainage. Cleanup in this zone will be closely coordinated with cleanup in the South Developed Zone and on the southern edge of the Railyard Zone.

The cleanup technologies for this zone include:

- Remove surface sediment
- Natural attenuation
- Enhanced bioremediation
- Excavation.

These technologies are described in the following subsections.

##### **Remove Surface Sediment**

The technology involves the excavation of the upper 4 inches (10 centimeters) of sediment to achieve cleanup levels in the biologically active zone. It is estimated that the full wetland area exceeds the sediment cleanup level including a small area on the downgradient side of the culvert (Figure 7-6). Assuming an excavation depth of 1 foot with over excavation, a total of 1,740 cy of sediment will be removed if excavation is to cleanup levels. A temporary cofferdam or deflector will be placed in the channel to keep soil and contamination away from surface water. Work will be performed in the summer to minimize the likelihood of precipitation. A bypass pump and hose will be used to pump any collected surface water around the excavation area.

Due to the high value of forested wetland, including the presence of mature trees, excavation of all impacted surface sediment would cause significant damage to the habitat. As a result, several alternatives have been developed that include removal of some surface sediment in strategic locations. For these alternatives, the excavation volume is assumed to be one half of the total removal volume or approximately 870 cy. For other alternatives, no excavation of surface sediment is proposed in this zone to avoid impacting the habitat.

##### **Natural Attenuation**

Natural attenuation might be used as the primary petroleum treatment method in the Former Maloney Creek Aquatic Zone due to the presence of the

wetland habitat and petroleum constituents at moderate concentrations (per Figure 3-11, only boring 2B-SD-5 has NWTPH-Dx concentrations above 3,200 mg/kg). Free product present on the adjacent South Developed Zone at MW-39 would be removed to accelerate natural attenuation. Natural attenuation will be monitored using compliance monitoring data. Dissolved oxygen data will also be collected because aerobic degradation is anticipated to be the primary method of petroleum degradation.

### **Enhanced Bioremediation**

Enhanced bioremediation is a viable *in situ* cleanup alternative for the Former Maloney Creek Aquatic Zone, and it will minimize adverse impacts on wetland habitat. Bench-scale testing of this technology has been performed and is described in detail in the Bench-Scale Cleanup Technology Testing Report (RETEC, 2004), and in Section 7.2 of this FS.

Bioremediation will target the more soluble and toxic components of TPH and soil TPH concentrations in the smear zone do not significantly exceed cleanup levels. Enhanced bioremediation will be implemented using air sparging techniques. Air sparging wells will be installed across the area that exceeds the soil direct contact cleanup level in the smear zone. These wells will be installed to completely cover this area, as illustrated in Figure 7-7. Wells will be installed at 25-foot spacing, with the top of the well screen 10 feet below the low water table elevation. Air will be injected at a rate of 2 to 3 scfm per well. Some wells might need to be angle-bored to minimize impacts to the wetland. The adverse impacts of drilling and operating wells in the wetland will be less significant (both in intensity and duration) than the impacts of excavating in the wetland.

Air bubbling up through the wetland represents a less negative impact to the habitat than excavation of surface sediment or soil. Compressed air will be supplied using positive displacement blowers located on the railyard in the vicinity of the former Maloney Creek channel. The blowers will be contained in insulated sound enclosures to reduce noise impacts. Compressed air piping will be placed in trenches to the maximum extent possible; however, in order to minimize impact to the wetland habit, much of the piping might be completed aboveground.

### **Excavation**

Excavation includes the removal of all soil exceeding a remediation level of 2,000 mg/kg NWTPH-Dx or the cleanup level from the zone, including surface sediment in the former Maloney Creek channel and the wetland areas (Figure 7-8). All brush and trees will be removed prior to excavation. A temporary dam will be placed in the channel to keep surface water away from the excavation and work will be performed in the summer to minimize the likelihood of precipitation. A bypass pump and hose will be used to pump any collected surface water around the excavation area. Disturbance of the

wetland area will require mitigation by creating equal or higher value wetlands. This mitigation will occur at the existing wetland and possibly at another, as-yet undetermined location within the Maloney Creek watershed.

Impacted surface sediment will be removed first. Any clean soil between the surface impacts and the smear zone will be excavated and placed in trucks for temporary stockpiling on the railyard. Impacted soil will then be loaded into trucks for temporary stockpiling prior to treatment or disposal. As the excavation proceeds, clean soil will be used as backfill in previously excavated areas. The total excavation volume is estimated to be 10,750 cy, with 10,020 cy requiring treatment or disposal based on the 2,000 mg/kg NWTPH-Dx RL. The excavation volume is estimated to be 21,320 cy, with 18,190 cy requiring treatment or disposal to achieve the cleanup level.

The estimated maximum depth of excavation is 10 feet. Excavation will include sloping sidewalls. Some excavation water will be managed to remove any free product that accumulates and to allow collection of excavation verification samples from the bottom of the excavation. Soil analysis will be performed with an on-site laboratory or using 48-hour turnaround at a fixed facility.

#### **7.4.1.3 Northeast Developed Zone**

The NE Developed Zone has been developed for residences, commercial buildings, streets, and institutions such as city hall. The NE Developed Zone is affected by a petroleum plume in smear zone soil and groundwater that is primarily composed of diesel fuel, generally greater than 75 percent. This petroleum is less viscous, more soluble, and more biodegradable than the petroleum present in the NW and South Developed Zones. An oil column was historically located in the vicinity of MW-21 where free product is present indicating that bunker C might be present in the immediate vicinity of MW-21 although there are no soil data to confirm this. Otherwise, the majority of the impacts appear to be associated with diesel fueling activities that occurred about 150 feet to the south of MW-21.

Cleanup technologies for this zone include:

- Natural attenuation
- Enhanced bioremediation
- Excavation.

These technologies are described in the following subsections.

##### **Natural Attenuation**

Natural attenuation in the NE Developed Zone has the potential to significantly reduce soil and groundwater concentrations due to the high percentage of diesel. Diesel-range hydrocarbons are soluble and

biodegradable and would be expected to attenuate in a reasonable timeframe. Soil direct contact criteria are only exceeded in a small area and groundwater currently appears to attenuate to cleanup levels prior to discharging to the South Fork Skykomish River. Natural attenuation will be monitored using compliance monitoring data. Dissolved oxygen data will also be collected because aerobic degradation is anticipated to be the primary method of petroleum degradation.

### **Enhanced Bioremediation**

Enhanced bioremediation is considered a viable alternative for the NE Developed Zone because the primary petroleum constituent is diesel. Bench-scale testing of this technology has been performed and is described in detail in the Bench-Scale Cleanup Technology Testing Report (RETEC, 2004), and in Section 7.2 of this FS.

Enhanced bioremediation has been implemented at multiple sites to achieve groundwater cleanup levels where thin accumulations (less than 2 feet) of diesel free product have been present. This is likely due to both the solubility and biodegradability of diesel constituents. RETEC's database of bench-scale testing data (Appendix M) indicates that soil concentrations of diesel are reduced, on average, by 90 percent due to the application of enhanced bioremediation techniques.

Air sparging wells will be installed across the area that exceeds the soil direct contact cleanup level in the smear zone and the groundwater cleanup level. Air sparging wells will be installed to completely cover the area of free product when free product is not flushed or excavated, as illustrated in Figure 7-9. Otherwise, a single row of air sparging wells will be used in this area. One or two additional rows of sparging wells will intersect the groundwater plume downgradient to the north depending on the desired restoration timeframe and accessibility of public and private property. The locations of air sparging rows have been selected to avoid generating vapors that could cause nuisance odors beneath inhabited buildings; vapor extraction will be included as a contingency should nuisance odors become a problem.

Wells will be installed at 25-foot spacing in each row, with the top of the well screen 10 feet below the low water table elevation. Air will be injected at a rate of 2 to 3 scfm per well. Compressed air will be supplied using positive displacement blowers located on the railyard near the depot. The blowers will be contained in insulated sound enclosures to reduce noise impacts. Compressed air piping will be placed in trenches located on BNSF property and public right-of-ways.

### **Excavation**

Excavation includes either the removal of free product, the removal of free product and soil exceeding the 2,000 mg/kg RL, or the removal of all free

product and all soil exceeding the cleanup level (Figure 7-10). For the free product-only excavation approach, the objective would be to excavate as much free product as possible without significantly impacting roads or utilities. This would limit the excavation to between Railroad Avenue and the BNSF property boundary in the vicinity of MW-21.

Two or three residences will need to be temporarily relocated to excavate all free product and contaminated soil above the RL in this zone while 5 or 6 residences and a telephone switching station will need to be temporarily relocated to excavate to the cleanup level. Use of shoring might be necessary to protect some structures and buildings. Utilities are also present, including a telephone switching station and associated fiber optics cables. A 2-inch water line is present on both Railroad Avenue and 3<sup>rd</sup> Street. Overhead power is present on the north side of Railroad Avenue and will need to be moved during excavation. All utilities will need to be protected or temporarily rerouted to facilitate excavation. A bypass road will be necessary to maintain access to residences east along Railroad Avenue.

Site clearing includes removal of asphalt paving, landscaping (including some large trees), and relocation or demolition of the residences. A significant thickness of clean soil exists in the vadose zone that will be excavated and stockpiled adjacent to the excavation area. Impacted soil will be loaded into trucks for temporary stockpiling prior to treatment or disposal. The total soil excavation volume for accessible free product is estimated to be 8,490 cy, with 3,320 cy requiring treatment or disposal. The soil excavation volume for all soil exceeding cleanup levels is estimated to be 66,450 cy with 27,470 cy requiring treatment or disposal. The soil excavation volume for all soil exceeding the 2,000 mg/kg NWTPH-Dx RL is estimated to be 28,830 cy with 12,380 cy requiring treatment or disposal. The estimated maximum depth of excavation is 17 feet.

#### **7.4.1.4 South Developed Zone**

The South Developed Zone affects two residences and involves petroleum in surface soil, smear zone soil and groundwater that is composed of mixed bunker C and diesel. These impacts appear to be limited in extent. Free product present in MW-39 is more viscous than free product noted elsewhere on the site and appears to be coincident with a previous channel of Maloney Creek that may have been affected by railyard operations. Cleanup of this zone will have to be closely coordinated with cleanup of the Former Maloney Creek Aquatic Zone.

The cleanup technologies for this zone include:

- Natural attenuation
- Excavation.

These technologies are described in the following subsections.

### **Natural Attenuation**

Natural attenuation in the South Developed Zone would only be used following free product excavation. The high viscosity of the product in MW-39 suggests that limited residual impacts will remain after free product removal. In addition, the free product appears to be associated with an earlier channel of Maloney Creek that is now backfilled. As a result, the impacts are suspected to be limited to this earlier channel and complete removal of this limited area may be possible. Natural attenuation will be monitored using compliance monitoring data. Dissolved oxygen data will also be collected because aerobic degradation is anticipated to be the primary method of petroleum degradation.

### **Excavation**

Due to the limited extent of impacts and the viscous nature of the free product, excavation is considered a viable cleanup technology for this zone. The approach to excavation might have to be altered based on the cleanup technology used at the Former Maloney Creek Aquatic Zone.

Excavation includes either free product excavation, excavation to soil RLs of 2,000 and 3,400 mg/kg NWTPH-Dx, or the complete removal of all free product and soil exceeding cleanup levels (22 mg/kg NWTPH-Dx) (Figure 7-11). Little to no clearing will be necessary for free product excavation, as it is primarily located in a grass area. The garage associated with one residence might need to be temporarily relocated or demolished and reconstructed to facilitate soil excavation. Utilities affected include services to the residences. All utilities will be temporarily disconnected or rerouted, as necessary.

A limited thickness of clean soil exists in the vadose zone that will be excavated and stockpiled adjacent to the excavation area. Impacted soil will be loaded into trucks for temporary stockpiling prior to treatment or disposal. The soil volume for excavating free product is estimated to be 690 cy, with 280 cy requiring treatment or disposal. The soil volume for excavating to the 3,400 mg/kg NWTPH-Dx RL is 4,520 cy, with 4,340 cy requiring treatment or disposal while the soil volume for excavating the 2,000 mg/kg NWTPH-Dx RL is 4,870 cy, with 4,670 cy requiring treatment or disposal. The soil volume for excavating all contaminated soil is 18,700 cy, with 16,320 cy requiring treatment or disposal.

#### **7.4.1.5 Northwest Developed Zone**

The NW Developed Zone has multiple residences, commercial buildings, streets, and institutions such as the school and community center. The zone is primarily affected by petroleum contaminants in the smear zone soil and groundwater and the petroleum consists of a mixture of diesel and bunker C. This is the largest and most developed zone at the site and includes several large or historic (Washington Heritage Register and National Register of Historic Places) buildings, such as Maloney's General Store, the Skykomish

Hotel and the School. This zone also has a very shallow smear zone that extends to within about 2 feet of ground surface in some areas, is very close to the levee and the South Fork Skykomish River.

Free product is present in this zone as two narrow bands between the railyard and the levee. The petroleum appears to originate in the vicinity of the former oil sump that was used to transfer bunker C from railcars to the aboveground 100,000 gallon oil storage tank on a 30-foot steel tower. This interpretation is based on free product thickness measurements, the location of oil seeps to the river, soil and groundwater data, known or suspected petroleum sources, and lithologic controls.

Interim actions have been performed in the NW Developed Zone that include (1) installation of free product skimming wells in 1996; (2) construction of a free product barrier wall in 2001; and (3) installation of new skimming wells and pumps, and upgrades to existing wells and pumps in 2002. These systems are effectively containing and capturing free product at the downgradient boundary of the NW Developed Zone and preventing migration from this zone into the levee and the South Fork Skykomish River, as evidenced by monitoring data from wells located at the ends of the barrier wall and product recovery.

In addition to these existing, interim measures, the cleanup technologies for this zone include:

- Surface soil excavation
- Natural attenuation
- Free product recovery trenches
- Enhanced bioremediation
- Excavation.

These technologies are described in the following subsections.

### **Surface Soil Excavation**

Lead-contaminated soil (250 mg/kg) was noted at seven sample locations within the NW Developed Zone (Figure 7-12). The locations are isolated and are not contiguous with the railyard. The source(s) of this lead is unknown (RETEC, 2002a). The lead soil exists in yards near residential or commercial properties and in the schoolyard. Because the source and distribution of the lead in soil is unknown, estimating excavation volume is difficult. Assuming 2-foot-deep excavations, 400 cy of soil will be excavated from throughout town using a backhoe. The excavated soil will be placed in trucks and transported to stockpiles on the railyard. The soil will be shipped to an off-site landfill by truck or rail. These areas will be backfilled and restored to pre-excavation conditions. Given the shallow excavation, no significant impacts to utilities, buildings, or structures are expected.

### **Natural Attenuation**

Natural attenuation in the NW Developed Zone would only be effective following free product removal. Once the free product is removed, natural attenuation will help address the residual soil and groundwater impacts. In each case where residual impacts remain in the NW Developed Zone, enhanced bioremediation will be implemented in the Levee Zone to protect people and animals that use the South Fork Skykomish River. Natural attenuation will address groundwater concentrations in the NW Developed Zone in the long term. Natural attenuation will be monitored using compliance monitoring data. Dissolved oxygen data will also be collected because aerobic degradation is anticipated to be the primary method of petroleum degradation.

### **Free Product Recovery Trenches**

Recovery trenches provide a minimally intrusive means to remove free product from the subsurface. The use of trenches relies on the hydraulic gradient to transport free product to the trenches. Trenches would be excavated using bioslurry techniques to 5 feet below the low water table. The trench backfill material would be designed to be compatible with native soil conditions and an impermeable barrier would be placed on the downgradient wall of the trench to prevent free product from escaping beyond the trench. Sumps will be placed in the trench at about 50-foot spacing.

Proposed locations of recovery trenches are illustrated in Figure 7-13. Excavation of these trenches will require work on public and private property and associated removal of pavement, landscaping or other features. Berms will be constructed around the trenching area to prevent loss of bioslurry overflows. Temporary mixing equipment, tanks, and pumps will be required near the excavation areas to supply bioslurry. Trench backfill material, impermeable barrier material, and sump material will also be stockpiled near the work area. Excavated material will be transported to the railyard for stockpiling prior to off-site shipment for disposal via rail or truck. The work surfaces will be replaced to pre-trenching conditions.

Electrically-driven skimmer pumps will be placed in vaults at each sump location and an electric control panel will be located nearby. No other aboveground features will be present. The skimming pumps will likely remain in operation for at least 10 years and may need to remain in operation for over 30 years.

### **Enhanced Bioremediation**

Enhanced bioremediation is not an effective cleanup technology by itself in the NW Developed Zone due to the presence of bunker C/diesel free product and significant soil impacts. This technology would only be used once the free product has been addressed by excavation. The purpose of this technology is to address residual soil and groundwater impacts to the

maximum extent practicable. Bench-scale testing of this technology has been performed and is described in detail in the Bench-Scale Cleanup Technology Testing Report (RETEC, 2004), and in Section 7.2 of this FS.

Enhanced bioremediation will be implemented using air sparging techniques. Air sparging introduces oxygen to the soil and groundwater to stimulate aerobic biodegradation in the vicinity of the air sparge wells and to other areas as the oxygenated groundwater migrates downgradient. Multiple rows of air sparging wells will be installed across the zone (Figure 7-14). These wells will be installed on public and private property. The locations of the sparging wells have been selected to minimize nuisance odors near inhabited buildings; vapor extraction will be retained as a contingency to address these odors should they become a concern. Wells will be installed at 25-foot spacing, with the top of the well screen 10 feet below the low water table elevation. Air will be injected at a rate of 2 to 3 scfm per well. Compressed air will be supplied using positive displacement blowers located on the railyard. These blowers will be contained in insulated sound enclosures to reduce noise impacts. Compressed air piping will be placed in trenches to connect the equipment on the railyard with the air sparging wells.

All work surfaces will be replaced to pre-cleanup conditions. A flush-with-grade monument will be present at each wellhead. All other equipment and activities will occur on the railyard.

### **Excavation**

Excavation in the NW Developed Zone includes one of the following (Figure 7-15):

- 1) Excavation to remove free product, where accessible
- 2) Excavation to remove all free product
- 3) Excavation of shallow smear zone impacts
- 4) Excavation to a soil RL of 20,000 mg/kg NWTPH-Dx
- 5) Excavation to a soil RL of 2,000 mg/kg NWTPH-Dx
- 6) Complete excavation of all free product areas and all soil exceeding cleanup levels.

These six scenarios are discussed individually below; however, all excavation work would occur during low water conditions to maximize access to impacted smear zone soil. Clean overburden soil will be stockpiled as close to the excavation as possible and will be used as clean backfill. Impacted soil will be hauled to the railyard and stockpiled for on-site treatment or hauling to an off-site landfill via rail or truck. All utilities will need to be protected or

temporarily rerouted to facilitate excavation. Various bypass roads will be necessary during excavation to maintain access to residences, businesses and public facilities. Site clearing includes removal of asphalt paving, landscaping (including some large trees), and relocation or demolition of several buildings and structures.

- **Excavation to remove free product, where accessible** – Excavation to remove free product, where accessible, is intended to minimize disruption to the community while removing a significant amount of free product. The long-term environmental benefit of this approach is questionable due to the patchwork of excavation that will occur (Figure 7-19). Accessibility is generally defined as anywhere a building is not present. As a result, excavation will still disrupt traffic and utilities. For the purpose of the FS, it is assumed that excavations will be sloped up to the sides of buildings that remain. Based on this approach, approximately 43,520 cy of soil will be excavated with 19,280 cy requiring treatment or disposal. All grades and surfaces will be replaced to pre-excavation conditions.
- **Excavation to remove all free product** – Excavation to remove all free product will require the temporary relocation and replacement or demolition and reconstruction of about eight buildings and temporary structural support to allow excavation underneath several other structures and buildings (Figure 7-19). These buildings include private residences, the hotel, the depot, the post office, the stove shop, the community center, and the teacher's cottage. Based on this approach, approximately 68,160 cy of soil will be excavated with 38,070 cy requiring treatment or disposal. All grades and surfaces will be replaced to pre-excavation conditions.
- **Excavation of shallow smear zone impacts** – Excavation of shallow smear zone impacts is intended to remove contaminated soil to a depth of 4 feet bgs in accessible areas (those areas not already covered by a structure or building). Cleanup to this depth will enable routine work in residential yards and public utility work without future exposure to contaminated soil. This work will disrupt traffic and utilities, but could be phased to allow residents to remain in their homes. Based on this approach, approximately 10,430 cy of soil will be excavated with 2,640 cy requiring treatment or disposal. All grades and surfaces will be replaced to pre-excavation conditions.
- **Excavation to soil RLs of 20,000 and 2,000 mg/kg NWTPH-Dx** – Both of these scenarios require the temporary relocation and

replacement or demolition and reconstruction of about 11 buildings and temporary structural support to allow excavation underneath several other buildings (Figure 7-19). The buildings affected by these excavations would include private residences, the hotel, the depot, the post office, the stove shop, the community center, the teacher's cottage, the school and portions of the motel. Based on the excavation to the soil RL of 20,000 mg/kg NWTPH-Dx, approximately 139,550 cy of soil will be excavated with 86,310 cy requiring treatment or disposal. Based on the excavation to the soil RL of 2,000 mg/kg NWTPH-Dx, approximately 159,440 cy of soil will be excavated with 97,820 cy requiring treatment or disposal. All grades and surfaces will be replaced to pre-excavation conditions and all buildings will be replaced or rebuilt.

- **Excavation to remove all soil above cleanup levels** – This scenario requires the temporary relocation and replacement or demolition and reconstruction of about 30 buildings and temporary structural support to allow excavation underneath several other buildings (Figure 7-19). Additional buildings affected by this excavation would include numerous private residences and the remainder of the motel. Based on the excavation of all soil exceeding cleanup levels, approximately 253,590 cy of soil will be excavated with 126,590 cy requiring treatment or disposal. All grades and surfaces will be replaced to pre-excavation conditions and all buildings will be replaced or rebuilt.

#### **7.4.1.6 Railyard**

The Railyard Zone has historically been used for industrial purposes and will continue as an industrial site for the foreseeable future. It includes BNSF property with surface and subsurface soil impacts. It also includes small areas immediately adjacent to the BNSF property: two with surface soil metals impacts, and one with surface and subsurface soil TPH impacts. The railyard has an active main line with two sidings and two other active sidings south of the main line area. Both passenger and cargo trains use the main line and sidings; approximately one train per hour passes the site.

All alternatives except one leave the rail lines in place and use *in situ* remedies to address these impacts, due to the expense and disruption associated with moving the main line. One alternative relies on excavation, as it is the only technology currently considered effective enough to result in a permanent removal of all contaminated soil throughout the site. Fiber optics, electrical, and signal lines are present within the Railyard Zone. Any crossing of the rail lines will require horizontal boring.

The cleanup technologies for this zone include:

- Excavate surface soil
- Capping
- Skimming free product
- Free product recovery trenches
- Natural attenuation
- Enhanced bioremediation
- Excavation.

These technologies are described in the following subsections.

### **Excavate Surface Soil**

Lead, arsenic, and TPH exceed the direct-contact cleanup criteria in several locations on the railyard. The impacted areas will be excavated to 2 feet below grade and will be capped with clean soil or ballast to prevent direct contact by site workers and trespassers. Based on the excavation outlines illustrated on Figure 7-16, it is estimated that 5,700 cy are associated with metals and an additional 6,600 cy are associated with TPH. Metals-impacted soil will be excavated in all site-wide alternatives to prevent exposure via dust. Soil exceeding cleanup levels will remain in place across much of the site; dermal contact will be prevented by a protective layer of clean soil (or ballast on the railyard).

Soil will be excavated using a backhoe or excavator. The excavated soil will be placed in trucks and transported to stockpiles on the railyard. The soil will be shipped to an off-site landfill by truck or rail. The excavated area will be lined with a woven-fabric, indicator layer to separate the subsurface-impacted soil from the clean-cap material.

### **Capping**

A permeable cap may be used to protect the following pathways on the railyard.

- **Windblown Transport:** A cap may be used to eliminate the potential for contaminated soil being blown from the railyard by wind. Several alternatives for this Zone include excavating all contaminated soil in the upper two feet, and backfilling the area with 2 feet of clean fill. Therefore, a permeable cap overlying TPH impacts greater than 2 feet in depth is proposed.
- **Direct Contact:** A cap is proposed to prevent people or wildlife from coming into direct contact with the contaminated material at the railyard. Several alternatives include excavation of the upper two feet of soil in areas where contamination exceeds the direct

contact cleanup levels. The excavated soil will be replaced with clean fill. This clean fill is, in effect, a permeable cap.

### **Skimming Free Product**

For site-wide alternatives with a conditional groundwater POC at the South Fork Skykomish River, aggressive free product removal on the railyard contributes little to no benefit to the protection of human health and the environment although it reduces the restoration time frame for groundwater on the railyard. For other alternatives, installation of skimming wells will remove free product up to the BNSF property boundary (alternative SW1) and at free product plumes within the railyard (alternatives SW2, SW3, SW4, and PB1). These wells will be installed at 50-foot centers at the downgradient edge of the free product plumes. Wells will be installed using standard drilling techniques and the wells will be screened across the range of water table fluctuation. The pumps will be housed in above-ground structures protected by bollards.

### **Free Product Recovery Trenches**

Recovery trenches provide a minimally intrusive means to remove free product from the subsurface. The use of trenches relies on the hydraulic gradient to transport free product to the trenches. Trenches would be excavated using bioslurry techniques to 5 feet below the low water table. The trench backfill material would be designed to be compatible with native soil conditions and an impermeable barrier would be placed on the downgradient wall of the trench to prevent free product from escaping beyond the trench. Sumps will be placed in the trench at about 50-foot spacing.

Proposed locations of recovery trenches are illustrated in Figure 7-17. Due to the location of free product on the railyard, recovery trenches are considered primarily for the downgradient zone/property boundary. Berms will be constructed around the trenching area to prevent loss of bioslurry overflows. Temporary mixing equipment, tanks, and pumps will be required near the excavation area to supply bioslurry. Trench backfill material, impermeable barrier material, and sump material will also be stockpiled near the work area. Excavated material will be stockpiled on the railyard prior to off-site shipment for disposal via rail or truck. The work surfaces will be replaced to pre-trenching conditions.

Electric skimming pumps will be placed in vaults at each sump location and an electric control panel will be located nearby. No other aboveground features will be present. The skimming pumps will likely remain in operation for a period exceeding 10 years.

### **Natural Attenuation**

Natural attenuation in the Railyard Zone would only be used following free product removal. Because of the presence of oil-range petroleum throughout

this zone, skimming wells and pumps, recovery trenches, excavation, or flushing will be used to remove the free product prior to relying on natural attenuation. Once the free product is removed, natural attenuation will help address the residual soil and groundwater impacts. Natural attenuation will be effective in this zone due to the distance between the railyard and the primary downgradient ecological receptor, the South Fork Skykomish River. Compliance with groundwater cleanup levels at the BNSF property boundary could be accelerated with enhanced bioremediation. Natural attenuation will be monitored using compliance monitoring data. Dissolved oxygen data will also be collected since aerobic degradation is anticipated to be the primary method of petroleum degradation.

### **Enhanced Bioremediation**

Enhanced bioremediation is not an effective cleanup technology by itself in the Railyard Zone due to the presence of bunker C/diesel free product and significant soil impacts. This technology will only be used once the significant impacts have been addressed by recovery trenches or excavation. Enhanced bioremediation will be implemented as a groundwater containment remedy using air sparging techniques. Bench-scale testing of this technology has been performed and is described in detail in the Bench-Scale Cleanup Technology Testing Report (RETEC, 2004), and in Section 7.2 of this FS. As a containment remedy, enhanced bioremediation will include a single row of air sparging wells located near the downgradient zone/property boundary (Figure 7-18). This row will stretch across the whole area where groundwater exceeds the remediation level (208 µg/L EPH/VPH).

Wells will be installed at 25-foot spacing, with the top of the well screen 10 feet below the low water table elevation, and air will be injected at a rate of 2 to 3 scfm per well. Compressed air will be supplied using positive displacement blowers located on the railyard. These blowers will be contained in insulated sound enclosures to reduce noise impacts. Compressed air piping will be placed in trenches to connect the equipment on the railyard with the air sparging wells.

All work surfaces will be replaced to pre-cleanup conditions. A flush-with-grade monument will be present at each wellhead. All other equipment will be restricted to a small equipment pad.

### **Excavation**

Excavation in the Railyard Zone includes either: (1) excavation of free product at the two southern free product plumes; (2) excavation to a soil RL of 2,000 mg/kg NWTPH-Dx; or, (3) the complete excavation of all free product areas and all contaminated soil above cleanup levels (Figure 7-19). These three scenarios are discussed individually below; however, all scenarios would occur during low water conditions to maximize access to impacted smear zone soil. Clean overburden soil will be stockpiled as close to the excavation as

possible and will be used as clean backfill. Impacted soil will be stockpiled on the railyard for on-site treatment or hauling to an off-site landfill via rail or truck. All utilities will need to be protected or temporarily rerouted to facilitate excavation. Little to no site clearing is required on the railyard although excavation of all contaminated soil will require temporary relocation of rail lines.

- **Excavation to Remove Free Product at the Two Southern Plumes –** This scenario is intended to maximize free product removal while avoiding disruption of railyard activities. This scenario will be used in conjunction with flushing to address the inaccessible free product areas. Accessibility is generally defined as anywhere a building or active rail line is not present. For the purpose of the FS, it is assumed that excavations will be sloped to maintain the stability of surface structures and rail lines. Based on this scenario, approximately 3,950 cy of soil will be excavated with 2,900 cy requiring treatment or disposal. All grades and surfaces will be replaced to pre-excavation conditions.
- **Excavation to a Soil RL of 2,000 mg/kg NWTPH-Dx and Excavation of All Contaminated Soil –** These scenarios are each only included in one remedial alternative. The excavations will require the temporary relocation and replacement of active rail lines to provide complete site access for excavation. Based on the excavation to a soil RL of 2,000 mg/kg NWTPH-Dx, approximately 185,340 cy of soil will be excavated with 129,980 cy requiring treatment or disposal. Based on the excavation of all soil exceeding cleanup levels, approximately 258,400 cy of soil will be excavated with 235,430 cy requiring treatment or disposal. All grades and surfaces will be replaced to pre-excavation conditions.

#### **7.4.1.7 Institutional Controls (All Cleanup Zones)**

Institutional controls are an essential component of any cleanup action, including the Preferred Alternative presented in Section 10. Even with the STD alternative (excavation of all soils to cleanup levels in all cleanup zones), institutional controls would be required for several years until the excavation work was completed and groundwater conditions stabilize. Institutional controls are legal or administrative measures designed to limit or control activities that could result in inadvertent exposure to contamination before, during, and after a cleanup action, particularly if contaminant residues are likely to remain above cleanup levels for an extended period of time. For many of the alternatives evaluated herein, soil and groundwater are likely to remain at concentrations above cleanup levels in the NE and NW Developed Zones for an extended period of time. These impacts will not present a threat to human health and the environment if institutional controls are properly utilized. For many of the alternatives presented in this FS, soil and

groundwater will also remain at concentrations above cleanup levels for an extended period of time on the Railyard where institutional controls will also be used. For the Skykomish cleanup, institutional controls will be designed to:

- Ensure access by BNSF or Ecology to remedial systems (e.g., cleanup or monitoring equipment) before, during and after active cleanup operations
- Protect residents, visitors, property owners and construction workers from exposure to hazardous substances on site during and after active cleanup operations.

A common form of institutional control that satisfies these objectives is a Restrictive Covenant that limits or restricts the use of a property. The Covenant is said to “run with the land” as provided by law and is binding on all current and future property owners and tenants. BNSF is currently negotiating agreements with individual property owners that include restrictive covenants. An example of such a covenant is provided in Appendix Q.

Another common form of institutional control is a local ordinance or a state rule or regulation. Local government, using its police powers, can limit the installation of groundwater wells in contaminated areas and can require proper management of soil and groundwater generated during excavation or drilling in contaminated areas. Including this type of condition to an existing permit system for grading would create an additional layer of protection to ensure that contaminated soil or groundwater are properly managed. It is currently envisioned that Town’s existing grading permit requirements for private property, and its existing permit system for work in public areas such as public rights-of-way and utility corridors, would be amended to control excavation and drilling in contaminated areas and that BNSF would be responsible for properly managing soil and groundwater generated during construction projects through agreements with the Town and/or individual property owners. Ecology already has a rule prohibiting new wells in contaminated zones.

The institutional controls would place controls or limitations on the use of contaminated groundwater and/or soils for certain properties. The controls alert property owners and/or anyone who would be conducting subsurface work (utility installations) of precautions that must be taken when working with certain soils and/or groundwater. The controls would specify at what soil depth special planning and management must be followed. Shallow non-contaminated soils would not be affected by the controls, and therefore typical activities such as gardening and plantings would not require any special actions by property owners. Utility installations, construction activities or

other such actions that may be desired by property owners would be allowed, the controls simply state precautions and procedures that must be followed when the activities involve contaminated soil and/or groundwater. The controls do prohibit the use of impacted groundwater. Appendix Q provides a specific example of the type of institutional controls that are currently being considered by property owners in Skykomish.

The SW and Preferred Alternatives will meet the groundwater cleanup level at the point where groundwater discharges to surface water. Therefore, long term institutional controls (anticipated to be in place much longer than 10 years) would be required on properties throughout the NW Developed Zone and the NE Developed Zones. As discussed in Section 10.8, five year reviews and ongoing technology development may result in remedial options that can be implemented at a later time to reduce or eliminate long-term institutional controls.

## **7.4.2 Description of Site-Wide Remedial Alternatives**

This section provides a summary description of each site-wide remedial alternative. More specific information regarding how each cleanup technology would be implemented in each cleanup zone is described in Section 7.4.1.

Site-wide remedial alternatives were developed to meet cleanup standards for the following three POCs: (1) off-property, conditional groundwater POC at the points of discharge to surface water (SW1 to SW4); (2) on-property, conditional groundwater POC at the property boundary (PB1 to PB5); and (3) the standard POCs (STD). Remedial alternative STD represents the most permanent alternative, and it meets cleanup levels at the standard POCs for all media. A No Action alternative is not presented in the tables but is retained in the text to satisfy SEPA requirements.

Table 7-3 summarizes how the groundwater POCs were combined with soil, sediment, and groundwater cleanup and remediation levels to develop the remedial alternatives. The matrix provides a basis for understanding the alternative development process and comparing the alternatives with respect to compliance with cleanup standards. Section 6 of this FS discusses remediation levels that would be applicable to each of these alternatives. Please refer to Section 6 for specific remediation levels to each alternative.

All of the alternatives in this FS (except No Action) can achieve cleanup standards and protect public health and the environment. Thus, the bulk of this document analyses the trade-offs between restoration time frame and degree of permanence (which includes cost), and minimizing adverse impacts to the built and natural environment. BNSF's preferred alternative, a combination of technologies and alternatives developed herein and selected based on the analysis presented in Sections 8 and 9, and on public and agency

comments to date, and on public and agency comments to date, is described in Section 10.

Table 7-4 provides a matrix that illustrates which remedial approaches were selected for each medium in each cleanup zone. Table 7-5 further expands this matrix by providing a summary description of the remedial approach for each zone for each site-wide remedial alternative.

#### **7.4.2.1 Alternatives with the Off-Property, Conditional Groundwater Point of Compliance**

The alternatives in this section were developed to meet an off-property, conditional groundwater POC (i.e., groundwater must achieve cleanup levels before discharging to the River or Maloney Creek). The SW alternatives will improve groundwater at the site but will not meet groundwater cleanup levels between BNSF property and the River. Per WAC 173-340-720 (8)(d)(ii), the affected property owners between the railyard and the surface water body must agree in writing to the use of the conditional point of compliance. The alternatives are discussed from left to right on Table 7-5 as you proceed through the discussions below. In general, more aggressive alternatives are more costly than less aggressive alternatives, thereby reducing restoration time and increasing permanence.

##### **Alternative SW1**

The cleanup technologies that combine to make up Alternative SW1 are listed on Table 7-5. Together these remedial approaches satisfy the minimum requirements of MTCA by removing free product, satisfying groundwater cleanup standards before reaching points of discharge, and providing containment and institutional controls to prevent dermal contact with soil off the railyard (Figure 7-20). This alternative permanently addresses the higher risk pathways of:

- Groundwater and oil discharges to the South Fork Skykomish River
- Contaminated surface soil that might cause dust or be a direct contact concern.

This alternative also minimizes short-term impacts to the community and the environment while relying on a long restoration timeframe and institutional controls to achieve cleanup.

This alternative consists of the following actions:

- Enhanced bioremediation in the Levee Aquatic Resource Zone

- Monitored natural attenuation in the Former Maloney Creek Aquatic Resource Zone
- Monitored natural attenuation in the Northeast Developed Zone
- Excavation of free product, surface soil with greater than 2,600 mg/kg NWTPH-Dx, and monitored natural attenuation in the South Developed Zone
- Excavation of surface soil with metals exceeding their cleanup levels, maintenance of the barrier wall and recovery system, and monitored natural attenuation in the Northwest Developed Zone
- Excavation of surface soil with metals exceeding their cleanup levels, capping, removal of free product by skimming, and monitored natural attenuation in the Railyard Zone
- Air quality monitoring where soil exceeding 2,900 mg/kg (total VPH/EPH) is present beneath buildings.

Natural attenuation is used in the Former Maloney Creek Aquatic Zone to minimize the potential for habitat damage while attempting to restore soil and groundwater that is moderately impacted by petroleum.

Sediment impacts in the Levee Zone and the former Maloney Creek channel will be addressed by natural recovery to avoid damage to the habitat and to maximize the net environmental benefit of the habitat.

### **Alternative SW2**

The cleanup technologies that combine to make up Alternative SW2 are listed on Table 7-5. Alternative SW2 builds on SW1 by adding the following elements:

- Free product recovery trenches in the NW Developed Zone to supplement the existing barrier wall and skimming system
- More aggressive free product recovery on the railyard by replacing skimming wells with recovery trenches at the property boundary and adding skimming wells to remove free product from the interior of the railyard.

A plan view illustrating the SW2 site-wide remedial alternative is provided in Figure 7-21. This alternative provides some additional short-term protectiveness but does not significantly shorten the long restoration time frame.

### **Alternative SW3**

The cleanup technologies that combine to make up Alternative SW3 are listed on Table 7-5. Alternative SW3 provides the following additional actions relative to SW2:

- Excavating free product in the levee to reduce the time frame required to eliminate seeps
- Removing impacted surface sediment associated with the free product removal in the levee noted above
- Implementing enhanced bioremediation in the NE Developed Zone to achieve soil and groundwater cleanup levels
- Excavating free product, where accessible, in the NW Developed Zone.

A plan view illustrating the SW3 site-wide remedial alternative is provided in Figure 7-22. This alternative provides additional short-term protectiveness in the Levee Aquatic Zone, reduces the time frame to permanently remove free product in the NW Developed Zones, and accelerates groundwater cleanup in the NE Developed Zone.

### **Alternative SW4**

The cleanup technologies that combine to make up Alternative SW4 are listed on Table 7-5. Alternative SW4 is evaluated with a conditional groundwater POC at the River and Maloney Creek. This alternative provides additional cleanup actions as follows:

- Excavating the levee to a soil remediation level (3,400 mg/kg NWTPH-Dx) that is protective of groundwater
- Removing all contaminated surface sediment in the South Fork Skykomish River
- Removing impacted surface sediment in the former Maloney Creek channel to the extent that it does not significantly damage the wetland
- Implementing enhanced bioremediation in the former Maloney Creek channel to address soil impacts and reduce the potential for recontamination of sediment
- Excavating all soil to a RL of 3,400 mg/kg NWTPH-Dx from the South Developed Zone

- Excavating all free product in the NW Developed Zone
- Excavating shallow smear zone impacts in the NW Developed Zone to 4 feet bgs to reduce the likelihood of direct contact by residents and public utility workers
- Excavating surficial soil with TPH concentrations greater than the direct contact cleanup level (2,600 mg/kg TPH-Dx) on the railyard in addition to metals exceeding their cleanup levels.

A plan view illustrating the SW4 site-wide remedial alternative is provided in Figure 7-23. This alternative accelerates cleanup in the Levee Aquatic Resource Zone and removal of free product, and it more permanently addresses direct contact risks.

#### **7.4.2.2 Alternatives with the On-Property, Conditional Groundwater Point of Compliance**

The alternatives in this section were developed to meet on-property conditional groundwater POC (i.e., groundwater must achieve cleanup standards as close as practicable to the source without exceeding the BNSF property boundary). Each of the PB alternatives will clean up groundwater from BNSF property to the River. The alternatives are discussed from left to right on Table 7-5 and as you proceed through the discussions below.

##### **Alternative PB1**

The cleanup technologies that combine to make up Alternative PB1 are listed on Table 7-5. Alternative PB1 removes free product, complies with groundwater cleanup standards, protects the South Fork Skykomish River and Maloney Creek, and provides containment and institutional controls to prevent dermal contact with soil off the railyard (Figure 7-24). This alternative consists of the following actions:

- Enhancing bioremediation in the Levee Aquatic Resource Zone
- Excavating surface metals, capping, skimming free product, recovering free product with recovery trenches, and monitoring natural attenuation in the Railyard Zone.

These actions permanently address the higher risk pathways of:

- Groundwater and oil discharges to the South Fork Skykomish River
- Contaminated surface soil that might be inhaled as dust or might be a direct contact concern.

The alternative also looks to address impacts beyond the property boundary by:

- Excavating the South Developed Zone to remove contaminated soil to an RL of 3,400 mg/kg NWTPH-Dx
- Excavating free product from the NW Developed Zone where accessible
- Excavating surface soil with metals exceeding their cleanup levels
- Implementing enhanced bioremediation in the NW Developed Zone
- Monitoring Natural Attenuation in the Former Maloney Creek Aquatic Resource Zone and the Northeast Developed Zone
- Air quality monitoring where soil exceeding 2,900 mg/kg (total VPH/EPH) is present beneath buildings.

A plan view illustrating the PB1 site-wide remedial alternative is provided in Figure 7-24.

### **Alternative PB2**

The cleanup technologies that combine to make up Alternative PB2 are listed on Table 7-5. Alternative PB2 builds on PB1 by adding the following elements:

- Excavating free product in the levee
- Removing impacted surface sediment associated with the free product removal in the levee noted above
- Implementing enhanced bioremediation in the NE Developed Zone
- Excavating free product and using enhanced bioremediation of groundwater at the property boundary to restore groundwater quality in the NW Developed Zone
- Using free product recovery trenches for the interior free product plumes on the Railyard rather than skimming pumps.

A plan view illustrating the PB2 site-wide remedial alternative is provided in Figure 7-25.

### **Alternative PB3**

The cleanup technologies that combine to make up Alternative PB3 are listed on Table 7-5. Alternative PB3 builds on PB2 by adding the following elements:

- Excavating free product and impacted soil to an RL of 3,400 mg/kg TPH-Dx in the levee
- Removing all contaminated surface sediment in the South Fork Skykomish River
- Removing contaminated surface sediment from the Former Maloney Creek channel to the extent that it does not significantly damage the wetland habitat
- Implementing enhanced bioremediation in the Former Maloney Creek Channel to address soil impacts and reduce the potential for recontamination of sediment
- Excavating all free product in the NW Developed Zone
- Excavating shallow smear zone impacts in the NW Developed Zone to 4 feet bgs to reduce the likelihood of direct contact by residents and public utility workers
- Excavating surface soil with TPH concentrations greater than the direct contact cleanup level (2,600 mg/kg TPH-Dx) on the Railyard in addition to metals, exceeding their cleanup levels.

A plan view illustrating the PB3 site-wide remedial alternative is provided in Figure 7-26.

### **Alternative PB4**

The cleanup technologies that combine to make up Alternative PB4 are listed on Table 7-5. Alternative PB4 provides additional action relative to PB3 as follows:

- Excavating all free product and soil impacts to an RL of 3,400 mg/kg NWTPH-Dx in the levee
- Removing all contaminated surface sediment in the former Maloney Creek channel
- Excavating free product in the NE Developed Zone in addition to enhanced bioremediation

- Excavating all free product and impacted soil to an RL of 20,000 mg/kg NWTPH-Dx
- Excavating the two southern free product areas on the railyard.

A plan view illustrating the PB4 site-wide remedial alternative is provided in Figure 7-27.

### **Alternative PB5**

The cleanup technologies that combine to make up Alternative PB5 are listed on Table 7-5. Alternative PB5 is similar to the STD alternative and includes excavation to a soil RL of 2,000 mg/kg NWTPH-Dx in all zones. Surface soil and sediment removal activities are the same as those proposed for PB4. A plan view illustrating the PB5 site-wide remedial alternative is provided in Figure 7-28.

#### **7.4.2.3 Standard Point of Compliance Alternative (STD)**

This alternative is included to satisfy the MTCA requirement that one remedial alternative be included in the FS that achieves cleanup levels for all media at standard POCs. Due to the physical and chemical properties of the petroleum impacts at Skykomish, this alternative relies primarily on excavation of all free product and all impacted soil.

Figure 7-29 shows the layout of these excavations for free product, soil, and sediment. The excavations will be performed to remove all free product, all soil above cleanup levels, and all sediment above cleanup levels. The River and Maloney Creek would be restored, the levee would be rebuilt and structures, buildings, roads and utilities would be replaced or rebuilt.

## **8 MTCA Evaluation of Remedial Alternatives**

This section evaluates each of the remedial alternatives with respect to threshold and other requirements for cleanup actions set forth in MTCA, Ch. 70.105D (WAC 173-340-360). The requirements of MTCA against which the alternatives are evaluated are first described in Section 8.1. The action and No Action alternatives are evaluated against MTCA requirements in Section 8.2 to 8.10, including a summary of the alternatives evaluated in Section 8.1. The alternatives are then evaluated on a comparative basis using the MTCA requirements in Section 9. BNSF's preferred alternative is described and evaluated in the same manner in Section 10.

### **8.1 Requirements for Remedial Alternatives**

Cleanup actions selected under MTCA must meet several requirements that address multiple factors in addition to the overarching goal of protecting human health and the environment. These requirements include threshold requirements and "other requirements" per WAC 73-340-360(2)(a) and (b) and as summarized in the following subsections. WAC 173-340-360(2)(c) through (h) minimum requirements were considered in developing the alternatives. The remedial alternatives are evaluated against these requirements in Sections 8.2 to 8.10. The final selection of a cleanup action will be based on the requirements of WAC 173-340-360(2). This comparative analysis is provided in Section 9.

#### **8.1.1 Threshold Requirements**

WAC 173-340-360(2)(a)) lists four threshold requirements for cleanup actions. All cleanup actions must:

- Protect human health and the environment
- Comply with cleanup standards
- Comply with applicable state and federal laws
- Provide for compliance monitoring

All of the alternatives presented in Section 7.3.2.1 (except No Action) are designed to meet these threshold requirements, as described below.

##### **8.1.1.1 Protect Human Health and the Environment and Comply with Cleanup Standards**

The SW alternatives protect human health and the environment by meeting cleanup standards for groundwater at a conditional point of compliance where groundwater discharges to the South Fork Skykomish River (Table 8-1). Free product will be removed, petroleum discharges to the river will be eliminated,

and surface soil contamination of the rail yard and the NW Developed Zone will be removed. Upland soil and groundwater between the rail yard and river will continue to exceed cleanup levels. Protection is achieved through containment (protective soil cap), institutional controls, and a long-term maintenance and monitoring program. MTCA evaluations of the SW alternatives are presented in Sections 8.2 to 8.5.

The PB alternatives meet groundwater standards at the railyard property boundary, another potential conditional point of compliance. Free product will be removed, petroleum discharges to the river and Maloney Creek will be eliminated, surface contamination on the rail yard and the NW Developed Zone will be removed and groundwater between the rail yard and river will be restored. MTCA evaluations of the PB alternatives are presented in Sections 8.6 to 8.9.

Subsurface soil on and off the rail yard will continue to exceed cleanup levels. Protection with respect to this material is achieved through containment, institutional controls and a long-term maintenance, inspection and monitoring program

The standard (STD) alternative achieves protection by meeting cleanup levels throughout the site for all media (sediment, groundwater, soil and surface water). Sediment cleanup is attained through some combination of natural recovery, removal, and enhanced bioremediation. All free product and contaminated soil is removed. Groundwater is restored to drinking water quality through natural attenuation following free product and soil removal. No long-term maintenance, inspection and monitoring program is required. MTCA evaluation of the STD alternative is presented in Section 8.10.

#### **8.1.1.2 Comply with State and Federal Laws**

Compliance with applicable state and federal laws is ensured, in part, through selection of the numeric cleanup levels (Section 5) that protect air, groundwater, surface water, and soil quality. Aside from cleanup levels, compliance must also be ensured in the manner by which prospective remedial alternatives are implemented. As described in Section 5, there are numerous laws and associated regulations that influence how any particular remedial action is implemented. Permitting by federal agencies, substantive standards promulgated by state and local agencies, best management practices, workplace safety, and off-site waste disposal practices are just a few of the aspects that must be formally addressed in the design and implementation phases of a cleanup action to ensure compliance with applicable laws. None of the alternatives possess features that cannot be designed and implemented in full compliance with these laws.

### **8.1.1.3 Provide for Compliance Monitoring**

Compliance monitoring refers to the collection, analysis, and reporting of environmental data to determine the short and long-term effectiveness of the cleanup action and whether protection is being achieved in accordance with the cleanup objectives. Compliance monitoring plans are developed in conjunction with the Cleanup Action Plan and typically involve standard field techniques and laboratory analytical methods. All of the remedial alternatives presented in Section 7 include comprehensive compliance monitoring plans that fulfill the requirements of WAC 173-340-410.

### **8.1.2 “Other Requirements”**

Under MTCA, alternatives that meet the threshold requirements described above must also meet the following “other requirements” (WAC 173-340-360(2)(b)):

- Use permanent solutions to the maximum extent practicable
- Provide for a reasonable restoration time frame
- Consider public concerns.

As the remedial alternatives were all designed to meet threshold requirements (except for No Action), the evaluation of remedial alternatives presented in this section focuses primarily on these other requirements that are described below. Table 8-2 is a compilation of relevant evaluation outcomes for each of the “Other Requirements” of cleanup actions under MTCA.

#### **8.1.2.1 Use Permanent Solutions to the Maximum Extent Practicable**

MTCA specifies that, when selecting a cleanup action, preference shall be given to actions that are “permanent to the maximum extent practicable.” Multiple approaches to cleanup are possible for this site. Selecting one that is permanent “to the maximum extent practicable” requires the weighing of costs and benefits. MTCA defines this balancing as a “substantial and disproportionate cost analysis” (WAC 173-340-360(3)(e)). The analysis can be both quantitative (e.g., degree of hazardous substance volume or mass reduction, costs) and qualitative (e.g., overall protectiveness, implementability, consideration of public concerns). Section 9 presents a substantial and disproportionate cost analysis for the remedial alternatives presented in this FS. The alternatives span a broad range of costs and have widely varying impacts on the community and environment. Often, however, the alternatives afford only incremental or minor degrees of protection and permanence.

One important measure of permanence is the degree to which an alternative reduces the mass or toxicity of contamination present. All of the alternatives (except No Action) remove soil contaminated with metals and thus are

equivalent in this regard. Hydrocarbons (in soil and as free product) are the major contaminants at the site, and removal or treatment of hydrocarbons is a useful measure of permanence with which to differentiate the alternatives.

In Section 9, an “equivalent soil volume” removed or treated is calculated for each alternative as a surrogate for hydrocarbon mass and permanence. An equivalent volume is a normalized or weighted volume based on the level of contamination and is determined as follows:

- Free product soil volume multiplied by a weighting factor of 40 (for mixed diesel and Bunker C free product areas)
- Diesel free product soil volume and impacted soil volume between 20,000 mg/kg NWTPH-Dx and free product multiplied by a weighting factor of 25 (for mixed diesel and Bunker C areas)
- Impacted soil volume between 3,400 mg/kg and 20,000 mg/kg NWTPH-Dx multiplied by a weighting factor of 11.7
- Impacted soil volume between 2,000 mg/kg and 20,000 mg/kg NWTPH-Dx multiplied by a weighting factor of 11
- Impacted soil volume between 20 mg/kg and 2,000 mg/kg NWTPH-Dx multiplied by a weighting factor of 1.

Soil containing metals was assigned a weighting factor of 1.

#### **8.1.2.2 Provide for a Reasonable Restoration Time Frame**

A reasonable restoration time frame is another requirement for evaluating alternatives. MTCA places a preference on those alternatives that, while equivalent in other respects (e.g., permanence, implementation risks to the community and environment, costs) can be implemented in a shorter period of time. Thus, while all of the alternatives (except No Action) attain cleanup standards, they vary in the time required to do so.

#### **8.1.2.3 Community Concerns**

Community concerns are considered by Ecology in the selection of cleanup actions and are formally obtained during required Public Notice and Participation periods per WAC 173-340-600. Earlier versions of the FS have undergone formal public comment to solicit comments from the community on the proposed remedial alternatives; these concerns have been considered in preparing the preferred alternative in Section 10 and in revising the FS to.

Issues of particular interest and concern to the community of Skykomish include the prospects for significant disruptions and disturbances (e.g., noise, traffic, temporary relocation of residents and buildings) that could attend a

cleanup action. In addition, the community has expressed concerns over the potential duration and effectiveness of cleanup actions, protection of the environment, protection of public health, public facilities such as the school, water supply, septic waste treatment and disposal, the local economy, and property values. While some of the socio-economic concerns of the community are not directly addressed through MTCA, the alternatives presented in this document span a range of actions that attempt to balance the concerns already expressed by the community with other MTCA factors such as permanence, effectiveness, restoration time frame, and avoiding or mitigating adverse impacts on the built and natural environment.

## **8.2 No Action Alternative**

This alternative includes continued use of the existing barrier wall and associated free product skimming system. This system (wall and skimmers) is collecting free product at the site at the leading edge of the plume and should ultimately result in the cessation of seeps to the South Fork Skykomish River. A dust suppressant will continue to be applied to metals-impacted surface soils on the railyard to minimize airborne exposures. Oil recovery booms will continue to be maintained along the River to recover oil. Long-term groundwater monitoring will also be performed. The alternative will not restore groundwater or sediment quality in Maloney Creek and the River. Further, the alternative will not fully protect people or ecological receptors from exposure to surface or subsurface contamination. The No Action alternative will effectively satisfy the MTCA requirement to collect free product.

No Action would not significantly affect the built environment. No roads, buildings or utilities would be physically damaged or disrupted. The long-term presence of contamination could deter future investment in the built environment and the community. The natural environment would continue to be significantly and adversely impacted by the contamination present.

## **8.3 Evaluation of Alternative SW1**

Alternative SW1 consists of:

- Enhancing bioremediation in the Levee Aquatic Resource Zone
- Monitoring natural attenuation in the Former Maloney Creek Aquatic Resource Zone
- Monitoring natural attenuation in the NE Developed Zone
- Excavating free product, excavating surface TPH and monitoring natural attenuation in the South Developed Zone

- Excavating surface metals, maintaining the barrier wall and recovery system, and monitoring natural attenuation in the NW Developed Zone
- Excavating surface metals, capping, skimming free product, and monitoring natural attenuation in the Railyard Zone
- Air quality monitoring where soil exceeding 2,900 mg/kg (total VPH/EPH) is present beneath buildings.

Protection of human health is achieved in the short-term (less than 1 year) through excavation of surface soil containing metals and implementation of institutional controls. Soil exceeding the cleanup level remains in place across much of the site and is isolated from the ground surface by a protective layer of clean soil (or ballast on the railyard). Threshold requirements are met after groundwater and sediment achieve cleanup standards, a process likely to take more than 30 years to complete.

SW1 is implementable from both a technical and administrative standpoint. Further, short-term risks during implementation are minor and manageable using standard methods and procedures for protecting workers and the community. Access agreements to private property are needed for monitoring.

Protection of human health is achieved by removal/disposal of surface soil containing metals. Isolation of soil exceeding cleanup levels and institutional controls to prevent exposures to contaminated media (soil, free product, and groundwater) is not permanent. In the long term groundwater will achieve protective concentrations due to the removal of free product. However, protection with respect to these media is achieved through long-term maintenance, inspection and monitoring.

Figure 8-1 provides an estimate of the extent of groundwater impacts above cleanup levels and the extent of free product after the active remediation phase. Active remediation includes excavation and enhanced bioremediation and is generally completed within 5 to 10 years after cleanup activities commence. Active remediation is distinct from long-term remediation activities which include enhanced bioremediation (for containment purposes), free product recovery trenches, and natural attenuation. An estimate of petroleum removal from long-term remediation activities is also provided on the figure.

## 8.4 Evaluation of Alternative SW2

Alternative SW2 consists of:

- Enhancing bioremediation in the Levee Aquatic Resource Zone

- Monitoring natural attenuation in the Former Maloney Creek Aquatic Resource Zone
- Monitoring attenuation in the NE Developed Zone
- Excavating free product, excavating surface TPH and monitoring natural attenuation in the South Developed Zone
- Installing free product recovery trenches, excavating surface metals and monitoring natural attenuation in the NW Developed Zone
- Excavating surface metals, capping, skimming free product, recovering free product with trenches and monitoring natural attenuation of groundwater in the Railyard Zone
- Air quality monitoring where soil exceeding 2,900 mg/kg (total VPH/EPH) is present beneath buildings.

The MTCA evaluation of Alternative SW2 is nearly equivalent to that for SW1 because of the minor technical differences between the two alternatives. With SW2, free product removal time decreases because of the greater number and density of free product recovery elements (trenches and well-based recovery equipment).

Access agreements to private property are needed to service and monitor free product recovery equipment.

As with SW1, protectiveness of human health is achieved by removal/disposal of surface soil containing metals. Isolation of subsurface soil exceeding cleanup levels and institutional controls to prevent exposures to contaminated media (soil, free product and groundwater) are effective but lack permanence and long-term protectiveness, as defined by MTCA.

Figure 8-2 provides an estimate of the extent of groundwater impacts above cleanup levels and the extent of free product after the active remediation phase. Active remediation includes excavation and enhanced bioremediation and is generally completed within 5 to 10 years after cleanup activities commence. Active remediation is distinct from long-term remediation activities which include enhanced bioremediation (for containment purposes), free product recovery trenches, and natural attenuation. An estimate of petroleum removal from long-term remediation activities is also provided on the figure.

## **8.5 Evaluation of Alternative SW3**

Alternative SW3 consists of:

- Excavating free product, excavating sediment to cleanup levels and enhancing bioremediation in the Levee Aquatic Resource Zone
- Monitoring natural attenuation in the Former Maloney Creek Aquatic Resource Zone
- Enhancing biodegradation in the NE Developed Zone
- Excavating free product, excavating surface TPH, and monitoring natural attenuation in the South Developed Zone
- Excavating free product where accessible, excavating surface metals and monitoring natural attenuation in the NW Developed Zone
- Excavating surface metals, capping, skimming free product, recovering free product with trenches and monitoring natural attenuation in the Railyard Zone
- Air quality monitoring where soil exceeding 2,900 mg/kg (total VPH/EPH) is present beneath buildings.

This alternative increases permanence and protectiveness over the previous alternatives (SW1 and SW2) by excavating free product in the NW Developed Zone (where accessible), excavating free product in the levee, removing contaminated sediments from the South Fork Skykomish River, and free product treatment in the NE Developed Zone using enhanced bioremediation. Free product remaining after excavation is prevented from reaching the South Fork Skykomish River by the existing barrier wall and passive recovery systems (trenches and skimmers) or with new recovery trenches placed in the vicinity of the existing barrier wall.

Access agreements are needed to excavate and monitor on private property. Disruption to the community occurs as a result of excavation work near homes and other infrastructure. Temporary road and utility service disruptions are likely.

This alternative reduces the restoration time frame relative to previous alternatives for attainment of sediment and groundwater cleanup levels at the off-property, conditional point of compliance at the levee. While increasing protectiveness and permanence with respect to free product removal, soil and groundwater are likely to remain above cleanup levels across most of the site

in the long-term. As with SW1 and SW2, protection is ensured through institutional controls.

Figure 8-3 provides an estimate of the extent of groundwater impacts above cleanup levels and the extent of free product after the active remediation phase. Active remediation includes excavation and enhanced bioremediation and is generally completed within 5 to 10 years after cleanup activities commence. Active remediation is distinct from long-term remediation activities which include enhanced bioremediation (for containment purposes), free product recovery trenches, and natural attenuation. An estimate of petroleum removal from long-term remediation activities is also provided on the figure.

## **8.6 Evaluation of Alternative SW4**

Alternative SW4 consists of:

- Excavating soil to 3,400 mg/kg NWTPH-Dx and free product, excavating sediment to cleanup levels and enhancing bioremediation in the Levee Aquatic Resource Zone
- Enhancing bioremediation and excavating sediment to remediation levels in the Former Maloney Creek Aquatic Resource Zone
- Enhancing bioremediation in the NE Developed Zone
- Excavating all soil above 3,400 mg/kg NWTPH-Dx in the South Developed Zone
- Excavating free product, surface metals, and soil in the shallow smear zone that exceeds 3,400 mg/kg NWTPH-Dx and monitoring natural attenuation in the NW Developed Zone
- Excavating surface metals and surface soil that exceeds 2,600 mg/kg NWTPH-Dx, capping, skimming free product, recovering free product using trenches and monitoring natural attenuation in the Railyard Zone
- Air quality monitoring where soil exceeding 2,900 mg/kg (total VPH/EPH) is present beneath buildings.

This alternative increases permanence and effectiveness over the previous alternative (SW3) by excavating all free product in the NW Developed Zone, removing shallow soil contamination in the NW Developed Zone (where accessible), removing near-surface, TPH-contaminated soil in the railyard and more aggressively attending to sediment impacts at the Former Maloney

Creek. Excavation is used at the levee to remediate free product and soil contamination.

Access agreements are needed to excavate and monitor on private property. Disruption to the community occurs as a result of excavation work near homes and other infrastructure. Temporary road and utility service disruptions are likely.

This alternative reduces restoration time frames (relative to the previous alternatives), primarily with respect to attainment of cleanup levels at the Aquatic Resource Zones. Actions in the Former Maloney Creek have significant impacts on the natural environment and may outweigh any benefit from restoration measures more aggressive than natural recovery.

Protectiveness and permanence are increased in the NW Developed Zone in that free product removal efficiency is greater. Nevertheless, soil and groundwater are likely to remain above cleanup levels across most of the site in the long-term. As with SW1, SW2 and SW3, protection is ensured through institutional controls.

Figure 8-4 provides an estimate of the extent of groundwater impacts above cleanup levels and the extent of free product after the active remediation phase. Active remediation includes excavation and enhanced bioremediation and is generally completed within 5 to 10 years after cleanup activities commence. Active remediation is distinct from long-term remediation activities which include enhanced bioremediation (for containment purposes), free product recovery trenches, and natural attenuation. An estimate of petroleum removal from long-term remediation activities is also provided on the figure.

## **8.7 Evaluation of Alternative PB1**

Alternative PB1 consists of:

- Enhancing bioremediation in the Levee Aquatic Resource Zone
- Monitoring natural attenuation in the Former Maloney Creek Aquatic Resource Zone
- Monitoring natural attenuation in the NE Developed Zone
- Excavating soil above a RL of 3,400 mg/kg NWTPH-Dx in the South Developed Zone
- Excavating free product where accessible, excavating surface metals and enhancing biodegradation in the NW Developed Zone

- Excavating surface metals, capping, skimming free product, recovering free product with trenches and monitoring natural attenuation in the Railyard Zone
- Air quality monitoring where soil exceeding 2,900 mg/kg (total VPH/EPH) is present beneath buildings.

Alternative PB1 protects human health and the environment and meets cleanup standards through a combination of sediment natural recovery, excavation, enhanced bioremediation, passive free product recovery, isolation of subsurface contaminated soil and institutional controls.

Excavation of metals contaminated surface soil, accessible free product in the NW Developed Area, and soil in the South Developed Zone can be accomplished within a 2-year planning horizon. These elements of Alternative PB1 are both permanent and protective. Remaining soil in excess of cleanup levels is isolated below a protective clean soil layer and cannot be contacted except under controlled circumstances (as stipulated in institutional controls). While effective, these measures are not considered permanent and protective under MTCA.

Enhanced bioremediation promotes restoration of groundwater quality between the railyard and the point at which groundwater discharges to the South Fork Skykomish River. This will likely require a restoration time frame of greater than 30 years in the NW Developed Zone. The results provided in the Bench-Scale Testing Report (RETEC, 2004) indicate enhanced bioremediation is anticipated to be both permanent and effective as the hydrocarbon contaminants are biodegradable, the technology is well developed, and system components are reliable.

Figure 8-5 provides an estimate of the extent of groundwater impacts above cleanup levels and the extent of free product after the active remediation phase. Active remediation includes excavation and enhanced bioremediation and is generally completed within 5 to 10 years after cleanup activities commence. Active remediation is distinct from long-term remediation activities which include enhanced bioremediation (for containment purposes), free product recovery trenches, and natural attenuation. An estimate of petroleum removal from long-term remediation activities is also provided on the figure.

## **8.8 Evaluation of Alternative PB2**

Alternative PB2 consists of:

- Excavating free product, excavating sediment to remediation levels (3,400 mg/kg NWTPH-Dx) and enhancing bioremediation in the Levee Aquatic Resource Zone

- Monitoring natural attenuation in the Former Maloney Creek Aquatic Resource Zone
- Enhancing biodegradation in the NE Developed Zone
- Excavating soil above a RL of 3,400 mg/kg NWTPH-Dx in the South Developed Zone
- Excavating all free product, excavating surface metals and enhancing biodegradation in the NW Developed Zone
- Excavating surface metals, capping, skimming free product, recovering free product with recovery trenches within the areas of free product, and enhancing biodegradation in the Railyard Zone
- Air quality monitoring where soil exceeding 2,900 mg/kg (total VPH/EPH) is present beneath buildings.

Alternative PB2 builds on provisions of PB1 by increasing the amount of enhanced bioremediation for developed areas north of the railyard and by increasing the permanence and effectiveness of soil and sediment cleanup actions at the levee through selective removal (excavation) and grouting. PB2 addresses all free product, not just accessible free product.

The removal of soil and free product at seep locations reduce the time required to restore sediment quality to protective levels. The greater enhanced bioremediation infrastructure, particularly in the NE Developed Zone, reduces the time required to restore groundwater quality. The complete removal of free product in the NW Developed Zone reduces the restoration timeframe for both soil and groundwater.

Figure 8-6 provides an estimate of the extent of groundwater impacts above cleanup levels and the extent of free product after the active remediation phase. Active remediation includes excavation and enhanced bioremediation and is generally completed within 5 to 10 years after cleanup activities commence. Active remediation is distinct from long-term remediation activities which include enhanced bioremediation (for containment purposes), free product recovery trenches, and natural attenuation. An estimate of petroleum removal from long-term remediation activities is also provided on the figure.

## 8.9 Evaluation of Alternative PB3

Alternative PB3 consists of:

- Free product excavation, excavating sediment to cleanup levels, soil to a RL of 3,400 mg/kg NWTPH-Dx, and enhancing bioremediation in the Levee Aquatic Resource Zone
- Enhancing biodegradation and excavating sediment to remediation levels in the Former Maloney Creek Aquatic Resource Zone
- Enhancing biodegradation in the NE Developed Zone
- Excavating soil above a RL of 3,400 mg/kg NWTPH-Dx in the South Developed Zone
- Excavating free product, excavating surface metals to CULs, excavating the shallow smear zone to 3,400 mg/kg NWTPH-Dx, and enhancing biodegradation in the NW Developed Zone
- Excavating surface metals and soil with NWTPH-Dx greater than 2,600 mg/kg, capping, recovering free product with trenches, and enhancing biodegradation in the Railyard Zone
- Air quality monitoring where soil exceeding 2,900 mg/kg (total VPH/EPH) is present beneath buildings

Alternative PB3 builds on provisions of PB2 primarily by reducing the restoration time frame for the Aquatic Resource Zones. More aggressive action is also taken at the levee to restore sediment and soil and groundwater quality at both the Levee and the former Maloney Creek.

Actions in the Former Maloney Creek have significant impacts on the natural environment and may outweigh any benefit from restoration measures more aggressive than natural recovery.

Figure 8-7 provides an estimate of the extent of groundwater impacts above cleanup levels and the extent of free product after the active remediation phase. Active remediation includes excavation and enhanced bioremediation and is generally completed within 5 to 10 years after cleanup activities commence. Active remediation is distinct from long-term remediation activities which include enhanced bioremediation (for containment purposes), free product recovery trenches, and natural attenuation. An estimate of petroleum removal from long-term remediation activities is also provided on the figure.

## **8.10 Evaluation of Alternative PB4**

Alternative PB4 consists of:

- Excavating the smear zone to a soil RL of 3,400 mg/kg NWTPH-Dx, excavating sediment to cleanup levels, and enhancing bioremediation in the Levee Aquatic Resources Zone
- Enhancing biodegradation and excavating sediment to cleanup levels in the Former Maloney Creek Aquatic Resource Zone
- Excavating free product and enhancing biodegradation in the NE Developed Zone
- Excavating soil above a RL of 3,400 mg/kg NWTPH-Dx in the South Developed Zone
- Excavating soil to a RL of 20,000 mg/kg NWTPH-Dx, excavating surface metals and the shallow smear zone and enhancing biodegradation in the NW Developed Zone
- Excavating free product at the two southern plumes, surface metals and TPH, capping, and enhancing biodegradation in the Railyard Zone
- Air quality monitoring where soil exceeding 2,900 mg/kg (total VPH/EPH) is present beneath buildings.

Alternative PB4 meets cleanup standards in off-railyard areas in approximately 10 years, except for soil and groundwater in the NW Developed Zone. All free product and residual product are removed by excavation. Sediment is removed to cleanup levels at the South Fork Skykomish River and in the former Maloney Creek channel.

Federal (Nationwide 38) permitting is required for sediment removal along the levee.

This alternative, while technically feasible, is very disruptive to the community and environment given the extended reach of cleanup operations in the NW Developed Zone. Residents would need to be temporarily displaced during excavation near homes. Residual contamination above soil cleanup levels would remain, thereby necessitating institutional controls to ensure protection.

Figure 8-8 provides an estimate of the extent of groundwater impacts above cleanup levels and the extent of free product after the active remediation phase. Active remediation includes excavation and enhanced bioremediation

and is generally completed within 5 to 10 years after cleanup activities commence. Active remediation is distinct from long-term remediation activities which include enhanced bioremediation (for containment purposes), free product recovery trenches, and natural attenuation. An estimate of petroleum removal from long-term remediation activities is also provided on the figure.

## **8.11 Evaluation of Alternative PB5**

Alternative PB5 consists of:

- Excavating the smear zone to a soil RL of 2,000 mg/kg NWTPH-Dx and excavating sediment to cleanup levels
- Excavating to a soil RL of 2,000 mg/kg NWTPH-Dx and excavating sediment to cleanup levels in the Former Maloney Creek Aquatic Resource Zone
- Excavating to a soil RL of 2,000 mg/kg NWTPH-Dx in the NE Developed Zone
- Excavating soil above a RL of 2,000 mg/kg NWTPH-Dx in the South Developed Zone
- Excavating soil to a RL of 2,000 mg/kg NWTPH-Dx and, excavating surface metals in the NW Developed Zone
- Excavating soil to a RL of 2,000 mg/kg NWTPH-Dx in the Railyard Zone
- Air quality monitoring where soil exceeding 2,900 mg/kg (total VPH/EPH) is present beneath buildings.

Alternative PB5 would likely achieve cleanup levels immediately after excavation was performed. Although numeric soil cleanup levels are below 2,000 mg/kg NWTPH-Dx, compliance monitoring would likely provide the empirical demonstration that soil is protective of groundwater that would allow removal of institutional controls.

While technically feasible and possessing a significant level of permanence, the PB5 alternative requires the removal or destruction and replacement of a significant number of homes and infrastructure, including the main rail line and a telecommunication switching station and associated fiber optics cables. This disruption includes the likelihood that the Skykomish School would be closed for one or more semesters. These are major short-term and possibly long-term consequences for the community.

Excavation of sediment in the levee and former Maloney Creek channel will result in short-term attainment of cleanup levels for soil and sediment at the expense of the existing natural habitat. Sediment and soil removal below the stream high water marks will require federal permitting (Nationwide 38).

Figure 8-9 provides an estimate of the extent of groundwater impacts above cleanup levels and the extent of free product after the active remediation phase. Active remediation includes excavation and enhanced bioremediation and is generally completed within 5 to 10 years after cleanup activities commence. Active remediation is distinct from long-term remediation activities which include enhanced bioremediation (for containment purposes), free product recovery trenches, and natural attenuation. An estimate of petroleum removal rates from long-term remediation activities is also provided on the figure.

## **8.12 Evaluation of Standard Alternative (STD)**

Alternative STD consists of:

- Excavating the smear zone and excavating sediment to cleanup levels in the Levee Aquatic Resource Zone
- Excavating the smear zone and excavating sediment to cleanup levels in the Former Maloney Creek Aquatic Resource Zone
- Excavating free product and the smear zone in the NE Developed Zone
- Excavating all soil above cleanup levels in the South Developed Zone
- Excavating all soil above cleanup levels in the NW Developed Zone
- Excavating all soil above cleanup levels in the Railyard Zone.

The standard alternative requires excavation of all free product and soil exceeding cleanup levels and is, therefore, the only alternative that meets the cleanup standard without the need for institutional controls. While technically feasible and possessing the maximum levels of permanence protectiveness of all alternatives, the standard alternative requires the removal or destruction and replacement of all homes and infrastructure in identified excavation areas, including the main rail line and a telecommunication switching station and associated fiber optics cables. This disruption includes the likelihood that the Skykomish School would be closed for one or more semesters. These are major short-term and possibly long-term consequences for the community.

Excavation of sediment in the levee and former Maloney Creek channel will result in short-term attainment of cleanup levels for soil and sediment at the expense of the existing natural habitat. Sediment and soil removal below the stream high water marks will require federal permitting (Nationwide 38).

Figure 8-10 provides an estimate of the extent of groundwater impacts above cleanup levels and the extent of free product after the active remediation phase. Active remediation includes excavation and enhanced bioremediation and is generally completed within 5 to 10 years after cleanup activities commence. Active remediation is distinct from long-term remediation activities which include enhanced bioremediation (for containment purposes), free product recovery trenches, and natural attenuation. An estimate of petroleum removal rates from long-term remediation activities is also provided on the figure.

## **8.13 Summary of Remedial Alternatives Evaluation**

This section summarizes the evaluation of remedial alternatives provided in Sections 8.2 to 8.12 in terms of MTCA requirements and the overall environmental impact analysis.

Table 8-3 provides a summary of the remedial alternatives, including the cleanup action proposed for each cleanup zone and the associated costs. Costs are based on the detailed calculations provided in Appendix N.

### **8.13.1 No Action**

The No Action alternative does not satisfy MTCA threshold requirements for meeting cleanup standards.

No Action would not significantly affect the built environment. No roads, buildings or utilities would be physically damaged or disrupted. The long-term presence of contamination could deter future investment in the built environment and the community. The natural environment would continue to be significantly and adversely impacted by the contamination present.

### **8.13.2 Standard Alternative**

The Standard Alternative removes all material from the site that exceeds cleanup levels. Following excavation, groundwater returns to protective levels by natural attenuation. While technically feasible and achieving a high level of protectiveness and permanence, this alternative would cause severe disruption to the community and local ecology. Residents would be displaced for at least several months depending on how the excavation work is phased. Houses and other buildings would be moved or demolished and utilities would need to be moved or demolished and ultimately replaced. The main track of

the BNSF rail line would need to be moved. The wetland ecology of the former Maloney Creek channel would be destroyed. Restoration measures at the former Maloney Creek channel could eventually create a biologically healthy ecology; however, the restoration of a wetland area with diverse and robust wetland ecology equivalent to what exists today cannot be ensured.

This alternative would yield a high level of protection through permanent removal of contamination from the site. Short-term risks could be managed with engineering controls commonly practiced at construction and hazardous material cleanup projects. While there was significant public support for the Standard Alternative specifically during the public comment on the Draft FS/EIS, and there was more broad support for the concept of completing the cleanup as quickly as possible, there was also substantial public opposition to moving or demolishing historic buildings such as the school.

### **8.13.3 SW Alternatives**

The SW alternatives are designed for a conditional point of compliance where groundwater discharges to surface water (South Fork Skykomish River). Adoption of any SW alternative and a conditional point of compliance at the River require the agreement of affected property owners. Approximately 30 properties are affected by contaminated groundwater (see Appendix O).

#### **MTCA Evaluation Summary**

As a group, the SW alternatives focus on groundwater cleanup through removal of free product and *in situ* bioremediation of groundwater before it affects the South Fork Skykomish River and former Maloney Creek. The need for and duration of bioremediation of groundwater depends on the effect removing free product has on reducing groundwater impacts to the River. Alternatives SW1 and SW2 will require long-term bioremediation of groundwater in the levee because they rely on passive recovery of free product upgradient of the barrier wall in the NW Developed Zone. Alternatives SW3 and SW4 ultimately transition from enhanced bioremediation to natural attenuation. Both offer more permanent and effective removal of free product and associated smear zone soil in the NW Developed Zone.

Soil cleanup is achieved, in all cases, by removing surface soil exceeding cleanup levels and applying institutional controls to protect against exposures to contaminated soil remaining at depth. Air quality will be monitored in all cases where soil exceeding 2,900 mg/kg (total VPH/EPH) is present beneath buildings. As mentioned above, SW3 and SW4 remove greater quantities of smear zone soil contamination than SW1 and SW2. Contaminated soil remaining at depth is isolated under a protective layer of clean overburden soil. The institutional controls protect against exposures to this material by obligating BNSF to assist property owners and other affected entities (e.g., utilities, the town of Skykomish) with managing contaminated soil and groundwater from construction work. The town and/or Ecology could adopt

regulatory prohibitions on drilling any new wells where public water is available.

All of the SW alternatives protect human health and the environment. Alternatives SW3 and SW4 are more permanent than SW1 and SW2 through removal of greater amounts of material, particularly in the NW and South Developed Zones (Table 7-2).

### **8.13.4 PB Alternatives**

The PB alternatives assume a conditional point of compliance for groundwater located at the BNSF property boundary rather than at the River.

#### **MTCA Evaluation Summary**

As with the SW alternatives, the PB alternatives focus on attainment of the groundwater cleanup standard through removal of free product and either natural attenuation, enhanced bioremediation or a combination of the two. The need for and duration of bioremediation of groundwater depends on the effect of removing free product has on reducing groundwater impacts at the BNSF property boundary.

All of the PB alternatives achieve soil cleanup by removing surface soil and subsurface soil to varying degrees after which institutional controls are invoked to protect against exposures to remaining contaminated soil at depth. Contaminated soil remaining at depth after the cleanup actions is isolated under a protective layer of clean overburden soil. Air quality will be monitored in all cases where soil exceeding 2,900 mg/kg (total VPH/EPH) is present beneath buildings. The institutional controls protect against exposures to this material by obligating BNSF to assist property owners and other affected entities (e.g., utilities, the town of Skykomish) with managing contaminated soil and groundwater from construction work. Alternatives PB3 and PB4 achieve greater permanence with respect to soil cleanup by removing or treating substantially greater amounts of contaminated soil in the NW Developed Zone (Table 7-2).

Cleanup of the Northeast Developed Zone is more likely to achieve cleanup standards due to the presence of more biodegradable petroleum constituents. Cleanup of the South Developed Zone is more likely to achieve cleanup standards due to the limited source area and the small area of concern.

Alternative PB5 provides the greatest level of permanence for the PB alternatives. Excavation to this extent will likely achieve cleanup levels, including an empirical demonstration that soil is protective of groundwater, in a very short timeframe after excavation is performed. Demonstrating compliance with cleanup levels will allow removal of institutional controls from the site.

All of the PB alternatives protect human health and the environment. Alternatives PB3 and PB4 are more permanent than PB1 and PB2 through removal of greater amounts of material, primarily in the NW Developed Zone (Table 7-2). Alternative PB5 is the most permanent of the PB alternatives.

## **9 MTCA Remedial Alternative Selection Process**

The purpose of the feasibility study as stated in WAC 173-340-350 (8)(a) “is to develop and evaluate cleanup action alternatives to enable a cleanup action to be selected for the site.” This section of the FS follows the requirements for selecting cleanup actions. It summarizes how each alternative complies with MTCA’s minimum requirements (WAC 173-340-360(2)(a)) and it illustrates how each remedial alternative is consistent with MTCA’s “other requirements” (WAC 173-340-360(2)(b)). It is important to remember throughout this section that impacts on the local region, population, and environment are also further evaluated in the environmental documents required by SEPA before Ecology selects a final remedy. Section 10 provides BNSF’s preferred alternative which is a combination of these technologies/alternatives resulting from this evaluation process. Analysis of the No Action Alternative is retained in this section for incorporation in the Final Environmental Impact Statement.

### **9.1 Threshold Requirements**

All cleanup actions shall fulfill the “threshold requirements” as specified in WAC 173-340-360(2)(a). This section describes how all the remedial alternatives presented in the Final FS meet these threshold requirements.

#### **9.1.1 Protect Human Health and the Environment**

Cleanup levels that protect human health and the environment are provided in Section 5. Protection can be achieved by excavating all contaminated soil and sediments and attaining these cleanup levels throughout the site, as described in alternative STD, or by containing contaminated soil and groundwater and using institutional controls to minimize long-term exposure. The use of containment and institutional controls is acceptable under MTCA (WAC 173-340-360(2)(e)) as long as the cleanup action meets threshold and other requirements, the institutional controls reduce risk, and the cleanup action does not “rely primarily on institutional controls where it is technically practicable to implement a more permanent cleanup action.” At a minimum, each alternative (other than No Action) will remove free product, eliminate discharges of petroleum to surface water, and remove contaminated surface soil.

### 9.1.1.1 Human Health

Section 5 demonstrates that the risks to human health under existing conditions at the site are the following:

- Direct contact with soil containing concentrations of TPH (based on the sum of EPH/VPH data) greater than 2,130 mg/kg in the vadose zone and 2,765 mg/kg in the smear zone, arsenic above 20 mg/kg, and lead above 250 mg/kg. These numeric criteria are based on a child ingesting 200 grams of soil per day for 6 years.
- The ingestion of groundwater or surface water and aquatic organisms for water containing greater than 477 µg/L TPH (based on the sum of EPH/VPH).

In order to eliminate these risks, each alternative addresses metal impacts in surface soil. The No Action alternative includes the continued application of Soil Sement™. All of the other alternatives include the excavation and capping of all surface metals in soil in both the NW Developed and Railyard Zones. All other soil impacts are not present in surface soil and, therefore, require some form of excavation before there is human exposure. Intermittent exposures to construction workers, utility workers or residents conducting occasional soil excavation can be controlled by institutional controls such as a city-managed grading permit process that includes environmental review to ensure direct contact exposures to subsurface soil are avoided and contaminated soil and groundwater are safely managed. Alternatives SW3 and PB1 include excavation of accessible free product in the NW Developed Zone and alternatives SW4, PB2, PB3, PB4, PB5, and STD include the complete removal of free product from the NW Developed Zone. These alternatives provide more permanent means of protecting residents and utility or construction workers from being accidentally exposed to soil that presents a risk while working in yards or public rights-of-way. Remedial alternatives SW4, PB3, and PB4 include an additional layer of permanence and protectiveness by excavating subsurface soil impacts to satisfy the cleanup levels wherever soil contamination is within 4 feet of the ground surface.

The community currently has a public drinking water supply that is not at risk of contamination from the site. State and local institutional controls prohibit installation of wells within contaminated areas. These include the King County Board of Public Health, *Public Water System Rules and Regulations* (Title 12) and the *Declaration of Covenant for Individual Water Supply*, both managed by the Department of Health; Town of Skykomish Ordinance; and Department of Ecology *Minimum Standards for Construction and Maintenance of Wells*, WAC 173-160. Even though human health risk related to groundwater is already controlled by the existing water supply system and institutional controls, MTCA generally requires that groundwater be cleaned-up to drinking water standards.

Human health cleanup levels for groundwater and surface water are based on restoring the water for use as drinking water. Off-railyard exceedances of the 477- $\mu\text{g/L}$  groundwater cleanup level are concurrent with free product (see Figure 3-9). Alternatives SW4, PB2, PB3, PB4, PB5, and STD aggressively address all free product in all off-railyard areas and achieve the groundwater cleanup level in all off-railyard areas in a relatively short timeframe (<10 years). Alternatives SW3 and PB1 also address free product and achieve the groundwater cleanup level over a longer timeframe (>30 years) in off-railyard areas, but in a manner than creates less disturbance to the community.

### **9.1.1.2 Environment**

Section 5 demonstrates that risks to the environment under existing conditions at the site are the following:

- Sediment in the South Fork Skykomish River that failed bioassay tests due to the presence of product seeps.
- Groundwater discharging to the South Fork Skykomish River and the Former Maloney Creek channel that may cause sediment to accumulate contaminants to levels that would present a risk to aquatic receptors. The groundwater TPH cleanup level is 208  $\mu\text{g/L}$  (as NWTPH-Dx) based on groundwater-sediment interaction.
- Groundwater discharging to the surface water of the South Fork Skykomish River and the Former Maloney Creek channel that would present a risk to aquatic receptors. A groundwater TPH cleanup level of 700  $\mu\text{g/L}$  (NWTPH-Dx) was developed based on WET testing bioassays on water column organisms.

Each alternative (other than No Action) provides groundwater treatment at the levee to treat groundwater to acceptable levels prior to discharge to the South Fork Skykomish River. More aggressive remedies, including free product or soil removal at the levee, are proposed for seven of the ten remedial alternatives. With respect to the former Maloney Creek channel, it is not clear that groundwater above cleanup levels is discharging into the channel, although it may be inferred from the data. Aggressive cleanup is proposed for all alternatives for the South Developed Zone, which is immediately upgradient of the former Maloney Creek channel and would be a source of groundwater that may discharge to the channel during certain times of the year. In addition, active groundwater treatment within the former Maloney Creek channel is proposed for alternatives SW4, PB3, and PB4.

Based on bioassays, some sediment in the South Fork Skykomish River has been identified for cleanup. In addition, a correlation of the bioassay results with TPH concentrations produces a numeric cleanup level of 40.9 mg/kg NWTPH-Dx. Some sediment in the former Maloney Creek channel has also

been identified for cleanup based on this cleanup level. Seven of the ten remedial alternatives include actively addressing these sediment impacts in the South Fork Skykomish River while five of the ten alternatives include actively addressing sediment impacts in the former Maloney Creek channel. Less aggressive approaches are included for other alternatives in an effort to avoid or minimize significant adverse environmental impacts that may outweigh the benefits of excavating sediments.

### 9.1.2 Comply With Cleanup Standards

Cleanup standards consist of both a cleanup level and a point of compliance where the cleanup level must be met (WAC 173-340-700). Per the regulation, “a cleanup level is the concentration of a hazardous substance in soil, water, air, or sediment that is determined to be protective of human health and the environment under specified exposure conditions.” For each alternative presented in this Final FS, standard points of compliance are used for all media except groundwater. Cleanup standards applicable to groundwater at the site include:

- For all SW alternatives, groundwater must achieve a cleanup level of 208 µg/L TPH (sum of EPH/VPH) prior to discharging to surface water (South Fork Skykomish River and Former Maloney Creek channel).
- For all PB alternatives, groundwater must achieve a cleanup level of 208 µg/L TPH (NWTPH-Dx) in all areas of town, except the railyard.
- For the STD alternative, groundwater must achieve a cleanup level of 208 µg/L TPH (sum of EPH/VPH) throughout the site, including the railyard.

Only remedial alternatives STD and PB5 can achieve groundwater cleanup levels at the standard point of compliance (i.e., throughout the site, including the railyard and off-railyard properties). STD and PB5 are considered permanent groundwater cleanup actions. Per WAC 173-340-360(2)(c)(ii), the less permanent groundwater cleanup actions shall include “removal [of] free product consisting of petroleum and other light nonaqueous phase liquid (LNAPL) from the groundwater using normally accepted engineering practices” and “ground water containment...to the maximum extent practicable to avoid lateral and vertical expansion of the ground water volume affected by the hazardous substance.” All of the SW and PB alternatives address these requirements through the use of barrier walls, skimming pumps, or recovery trenches, all of which are normal engineering practice for removing heavy, viscous free product. More aggressive approaches have been included such as excavation near higher risk areas. Enhanced bioremediation and excavation can effectively remove the diesel-range free product from the

NE Developed Zone. Monitored natural attenuation is proposed in some areas to avoid or minimize significant adverse effects on the built and natural environment.

STD achieves all groundwater, soil, surface water and sediment cleanup levels at the standard points of compliance. It is, therefore, the most permanent alternative considered in this Final FS. Institutional controls are required to ensure compliance with cleanup standards and must be implemented in accordance with WAC 173-340-440. For the STD alternative, institutional controls are required in the short-term (<8 years) to minimize the risk of exposure while the remedy is being implemented. For all of the other alternatives (PB and SW), long-term (10+ years) institutional controls are required to comply with cleanup standards. Institutional controls include restrictive covenants on individual properties and legal or administrative mechanisms. Restrictive covenants require the consent of the property owner of the property with contamination above cleanup levels to which the restrictive covenant is applied. Legal or administrative mechanisms include “zoning overlays, placing notices in local building department records or state lands records, public notices and education mailings.” State and local institutional controls already in place prohibit installation of wells within contaminated areas. Additional institutional controls (ordinances and private agreements) can further limit exposure and provide a mechanism for BNSF (or the Town with technical and financial assistance from BNSF) to safely manage contaminated soil and water encountered during construction activities on private and public properties. In this case, the primary technical and financial assistance from BNSF would likely be making a qualified environmental contractor available, without charge, to plan for and manage contaminated soil and groundwater encountered during construction activities. Any of these institutional controls could be removed or modified once the cleanup is completed.

All of the proposed remedial alternatives are intended to comply with cleanup standards. Compliance with cleanup standards would be demonstrated by monitoring during implementation of the cleanup action and over the long-term.

### **9.1.3 Comply With Applicable Local, State and Federal Laws**

Several applicable local, state and federal laws have been incorporated into the cleanup level development process included in this Final FS. These include the Sediment Management Standards (WAC 173-204) and the State Environmental Policy Act (WAC 197-11-400). Additional laws may apply to implementation of the cleanup action. An example is Section 404 of the Clean Water Act that will require permitting and mitigation associated with cleanup actions that impact the South Fork Skykomish River or the wetland at

the former Maloney Creek channel. All of the alternatives included in the Final FS can be designed to comply with applicable local, state and federal laws.

#### **9.1.4 Provide for Compliance Monitoring**

Compliance monitoring is not a cleanup element that is described in detail during the Final FS process. These provisions are better developed in the Cleanup Action Plan and detailed Compliance Monitoring Plans are developed during Engineering Design of the cleanup action. Compliance Monitoring Plans provide for a monitoring program to ensure that cleanup levels are obtained and include provisions for contingent remedies should the initial remedy fail. All of the alternatives in the Final FS can be designed to provide all phases of compliance monitoring, including protection, performance and conformational monitoring.

### **9.2 Use Permanent Solutions to the Maximum Extent Practicable**

The first of three “other requirements” for selection of cleanup actions under MTCA is the use of permanent solutions to the maximum extent practicable. The procedure for determining whether a cleanup action uses permanent solutions to the maximum extent practicable is provided in WAC 173-340-360(3). This section presents a “disproportionate cost analysis” to compare the relative costs and benefits of all the alternatives. Costs are disproportional to benefits if the incremental cost of an alternative exceeds the incremental benefit achieved with the additional cost. The analysis may be quantitative or qualitative. The analysis begins by ranking alternatives from the most permanent to the least permanent. Once alternatives are ranked from the most permanent to the least permanent, they are evaluated based on seven criteria in WAC 173-340-360(f).

A “permanent cleanup action” achieves cleanup standards without further action at the site, such as long-term monitoring, maintenance or institutional controls (WAC 173-340-200). Section 8.1.2.1 describes a process for quantifying permanence. The measure was termed “equivalent soil volume.” An alternative that treats or removes a greater equivalent soil volume may be considered more permanent because it represents a larger reduction in the volume of hazardous substances at the site and a reduced need for long-term monitoring, maintenance or institutional controls. The remedial alternatives are ranked in Figure 9-1 from the most permanent (STD) to the least permanent (No Action).

#### **9.2.1 Protectiveness**

Protectiveness of human health and the environment includes the degree to which existing risks are reduced, time required to reduce risk at the site and

attain cleanup standards, on-site and off-site risks resulting from implementing the alternative, and improvement of the overall environmental quality.

As discussed in Section 8.1.1.1, all of the remedial alternatives are designed to aggressively address possible human health risk associated with exposure to impacted surface soil. With respect to subsurface soil, alternatives SW4, PB3, and PB4 provide some additional protectiveness from dermal contact relative to the other alternatives by removing all impacts from within 4 feet of ground surface. While human health risk associated with consumption of groundwater is already controlled, alternatives SW3, SW4, PB1, PB2, and PB3 all aggressively address free product in the NW Developed Zone which are the only off-railyard areas that exceed the human health groundwater remediation level of 477 µg/L outside of the NE Developed Zone (diesel impacts). 2A-W-6 has a TPH (sum of EPH/VPH) in excess of the criteria but is just outside the free product plume in the NE Developed Zone; however, this area will be addressed via enhanced bioremediation for the same alternatives listed above (SW3, SW4, PB1, PB2, PB3).

Alternatives SW4, PB3, PB4, and PB5 provide the greatest level of environmental protectiveness by addressing soil and sediment in the Former Maloney Creek channel and by addressing soil, sediment, and free product at the Levee. SW3 and PB2 provide a moderate level of environmental protectiveness by actively addressing sediment and free product at the Levee. SW1, SW2, and PB1 all provide a lower level of environmental protectiveness.

## **9.2.2 Permanence**

Permanence was discussed earlier and the relative permanence of the remedial alternatives was illustrated in Figure 9-1.

## **9.2.3 Cost**

Costs for each remedial alternative were developed as part of the FS process. Figure 9-2 indicates the cost for each alternative with the alternatives ranked by level of permanence. Detailed cost estimates are provided in Appendix N. The largest cost elements are associated with cleanup of the NW Developed Zone, the levee, and the railyard. Cleanup of the other three zones combined contribute on the order of 15 percent or less of total costs. The total project costs range from less than \$10 million to over \$70 million.

Figure 9-3 illustrates the cost to achieve the increasing levels of permanence. Lower unit costs (total cost divided by total equivalent soil volume) indicate increased cost-effectiveness of the remedial alternative with respect to equivalent soil volume removal or treatment where equivalent soil removal

volumes are used as a surrogate for contaminant mass removal and permanence.

## **9.2.4 Effectiveness over the Long-Term**

Long-term effectiveness includes “the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time hazardous substances are expected to remain on-site at concentrations above cleanup levels, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes.” MTCA suggests the use of the use of the following hierarchy of cleanup action components in descending order of long-term effectiveness:

- 1) Reuse or recycling
- 2) Destruction or detoxification
- 3) Immobilization or solidification
- 4) On- or off-site disposal
- 5) On-site isolation or containment
- 6) Institutional controls.

The remedial technologies in the proposed remedial alternatives fit this hierarchy as follows:

- 1) Reuse or recycling (free product skimming or trenches with free product recovery and recycling)
- 2) Destruction or detoxification (natural attenuation and enhanced bioremediation)
- 3) Immobilization or solidification (none)
- 4) Excavation (requires off-site disposal)
- 5) Institutional controls.

Based on the suggestion in MTCA, equivalent soil volumes were calculated for each cleanup action component for each alternative (see Appendix P). The volumes were then divided by the hierarchy number and summed for each alternative to derive a normalized equivalent soil volume. The higher normalized equivalent soil volume suggests a higher level of long-term effectiveness. This approach was used to score the alternatives from 0 to 5 points. The other 5 points were scored based on site remediation activities that were most likely to contribute to the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time that hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels, the magnitude of residual risk with

the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes. The resulting scores for long-term effectiveness are provided in Table 9-1. Alternative PB4 ranks highest, followed by STD and PB5.

### **9.2.5 Management of Short-Term Risks**

Impacts from remedial action implementation include vehicle traffic, temporary relocation of residences/buildings, temporary closure of the school and other public facilities, odor, open excavations, and noise, dust and safety concerns associated with extensive heavy equipment activity. The greatest short-term risk to human health is related to safety and general construction activity. As a result, the short-term risks to human health would be greatest for the more permanent alternatives. In all cases, similar measures would be taken to manage risk such as fencing, signage, dust controls, and traffic control.

With respect to short-term risks to the environment, more aggressive remedies in the aquatic resource zones present a greater short-term risk to the environment. So, similar to human health risks, the short-term risks to the environment would be greatest for the more permanent alternatives. In all cases, similar measures would be taken to manage risk such as temporary dams to prevent surface water discharges, angle boring to minimize drilling in sensitive areas, and scheduling work to avoid sensitive species during critical stages.

### **9.2.6 Technical and Administrative Implementability**

Three major administrative concerns with the remedial alternatives are institutional controls, permitting, and relocating residents, businesses, transportation facilities and public facilities such as the school. All SW and PB alternatives require long-term institutional controls on off-railyard properties where soil and/or groundwater will remain above cleanup levels for extended periods of time. Alternatives SW3, SW4, PB2, PB3, PB4, PB5, and STD will treat soil and groundwater to cleanup levels in a shorter timeframe in the NE Developed Zone. Alternatives SW4, PB1, PB2, PB3, PB4, PB5, and STD will achieve cleanup levels in the South Developed Zone. Alternatives PB5, STD, and possibly PB4, will achieve groundwater cleanup levels in the NW Developed Zone. Alternatives PB4 and PB5 will substantially reduce the number of properties with soil above cleanup levels while only alternative STD will result in no properties with soil above cleanup levels in the shortest period of time. The administrative implementability of these alternatives would be proportionate to the number of properties requiring some form of institutional control and the length of time these controls must be enforced.

The second administrative implementability issues relates to permitting and mitigating cleanup actions at the Levee and the former Maloney Creek channel. Permits are required from the US Army Corps of Engineers under Section 404 of the Clean Water Act, and the Endangered Species Act requires the Corps to consult with NOAA-Fisheries and the U.S. Fish and Wildlife Service. In addition, incidental take permits may be required under the Endangered Species Act. Permitting of environmental cleanup activities under this process is expected to take 1 to 2 years. Natural attenuation in the former Maloney Creek channel and enhanced bioremediation or ozone sparging in the Levee would not involve these administrative requirements (as well as the adverse environmental impacts associated with excavating in wetlands and streams). All other approaches would likely require this permit. In addition, any invasive work on or in the Levee will require coordination with King County to ensure the structural integrity of the Levee is not compromised. This applies to all remedial alternatives affecting the Levee.

Finally, the more aggressive remedies (PB4, PB5, and STD) necessarily involve administrative and technical challenges associated with extensive excavation around and under buildings and facilities such as the school, the community center, residences, businesses, the main rail line, streets and utilities. Alternative facilities would be required for students, faculty and staff. Temporary dwellings would be required for residents. Businesses and the community center would have to close or relocate to other buildings that may be available in town. Rail traffic (24 trains/day) might have to be rerouted or temporary alternative routes would have to be constructed through town. Even for some of the less aggressive alternatives (such as SW2, SW3 and PB1) if technologies such as natural attenuation, free product recovery and sparging in the NW Developed Zone prove ineffective, then excavation may be needed near or beneath structures and buildings. In general, however, technical and administrative implementability decreases with increasing permanence.

### **9.2.7 Consideration of Public Concerns**

The public comment process includes review of the Draft FS/EIS and other public meetings and forms hosted by Ecology or BNSF. Public comments on the FS have been received. These comments were incorporated in the development of the preferred alternative in Section 10.

### **9.2.8 Permanence to the Maximum Extent Summary**

As noted at the beginning of this section, the analysis of whether an alternative is permanent to the maximum extent practicable involves the comparison of the alternatives based on the seven evaluation criteria as described above. The goal is to determine whether the incremental cost of an alternative is disproportionate to the incremental benefit relative to the lower cost alternative (WAC 173-340-360(e)(i)). A systematic approach was

developed to quantify the relative benefit of the alternatives. The total benefit of each alternative was calculated as the sum of ratings for five of the evaluation criteria:

- 1) Protectiveness
- 2) Permanence
- 3) Effectiveness over the long-term
- 4) Management of short-term risks
- 5) Technical and administrative feasibility.

Consideration of public concerns is based on the public comment received on the Draft FS/EIS and cost is part of the analysis to determine if the incremental cost of an alternative is disproportionate to the incremental benefit relative to the lower cost alternative. The benefit ratings are provided in Table 9-1 and Figure 9-4 illustrates these benefit ratings and alternative costs.

Figure 9-4 indicates generally comparable levels of benefit for the six most aggressive alternatives. Cost is shown, but not taken into account in regard to the benefit rating on this figure. Benefit is based on the MTCA criteria described above. Figure 9-4 does not take into account restoration time frame of the alternatives (this is shown in Section 9.3).

To further evaluate the ratings, benefit was plotted versus cost in Figure 9-5. Where a tangent to this curve is steeper (closer to vertical) indicates a greater incremental benefit per incremental dollar expended. For example, the Figure 9-5 analysis shows notable benefit gain for the added cost in alternative SW3 over SW2, and PB2 over PB1. Comparatively, alternatives PB4, PB5, and STD show significantly higher costs without significant increases in benefit. This analysis of benefit includes consideration of MTCA items such as a preference for *in situ* and/or technologies that do not require off-site disposal.

MTCA states that the most practicable permanent alternative shall be the “baseline cleanup action” against which other alternatives are compared (WAC 173-340-360(e)(ii)(B)). To evaluate the alternatives using this criterion, the alternative STD was considered the most practicable permanent alternative and the other alternatives were plotted based on the percentage incremental benefit and decrease in cost versus STD (Figure 9-6). To determine the alternative with the most desirable cost-benefit result, move a line, like the hand of a clock with the STD alternative located where the hand attaches to the clock, in a clockwise direction. This analysis shows that alternative PB4 ranks the highest in the cost-benefit analysis, followed closely by alternatives PB2, SW4, and PB3, respectively.

## **9.3 Provide for a Reasonable Restoration Timeframe**

The second of three “other requirements” for selection of cleanup actions under MTCA is a reasonable restoration timeframe. Restoration timeframe is the time it takes to meet cleanup standards; i.e., to meet all cleanup levels in all media at all points of compliance. A cleanup action can meet cleanup standards through the use of treatment, removal or containment, or some combination of these three approaches. Each alternative relies on removal of free product and restoring groundwater before it discharges to surface water. The PB alternatives rely on containment and institutional controls for soil in off-railyard areas while the SW alternatives rely on containment and institutional controls for both soil and groundwater in off-railyard areas.

Estimates of time to remove free product and restoration timeframes for groundwater and soil were generated for each zone and remedial alternative. These estimates assume that containment and institutional controls can be established for off-railyard areas for soil and groundwater for the SW alternatives and for soil for the PB alternatives. Figures 9-7 through 9-9 illustrate the estimated restoration timeframes. These charts present the mid-point from estimated ranges in Table 8-2, as follows:

- “4 years” represents a 3 to 5 year range
- “8 years” represents a 5 to 10 year range
- “15 years” represents a 10 to 20 year range
- “25 years” represents a 20 to 30 year range
- “40 years” represents greater than 30 years.

The procedure for determining whether a cleanup action provides for a reasonable restoration timeframe is provided in WAC 173-340-360(4). The nine factors used to determine whether a cleanup action provides for a reasonable restoration timeframe are provided in the rule and include:

- 1) Potential risks posed by the site to human health and the environment
- 2) Practicability of achieving a shorter restoration timeframe
- 3) Current use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site
- 4) Potential future use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site
- 5) Availability of alternative water supplies

- 6) Likely effectiveness and reliability of institutional controls
- 7) Ability to control and monitor migration of substances from the site
- 8) Toxicity of hazardous substances at the site
- 9) Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the site or under similar conditions.

The rule (WAC 173-340-360(4)(c)) also states that: “a longer period of time may be used for the restoration timeframe for a site to achieve cleanup levels at the point of compliance if the cleanup action selected has a greater degree of long-term effectiveness than on-site or off-site disposal, isolation, or containment options”.

Figure 9-7 indicates that free product will be removed from all off-railyard areas within 10 years for alternatives SW4, PB2, PB3, PB4, PB5, and STD. Free product will remain on the Railyard for >30 years for most alternatives, except PB5 and STD; these two alternatives would remove free product within a couple of years.

Figure 9-8 indicates that all alternatives achieve cleanup standards for groundwater within 10 years, except for PB1, PB2, PB3, and PB4. This restoration timeframe reflects the different groundwater points of compliance between the SW (points of discharge to surface water) and PB (railyard property boundary) alternatives. Figure 9-9 indicates that only alternatives PB5 and STD achieve soil cleanup levels with 10 years and PB5 will require an empirical demonstration that the soil cleanup level protective of groundwater has been achieved. Alternatives SW3, SW4, PB2, and PB3 achieve soil cleanup levels in all off-railyard zones, except the Northwest Developed Zone, within 20 years. PB4 reduces the restoration timeframe to 10 years for these same zones.

## 9.4 Consider Public Concerns

The third of the three “Other Requirements” in MTCA is to consider public concerns. The public comment process included public and regulatory agency review of the Draft FS/EIS. With respect to MTCA, specific comments regarding whether the proposed alternatives provide for a reasonable restoration timeframe were considered by BNSF while preparing the preferred alternative described in Section 10.

## **9.5 SEPA Analysis**

An EIS is generally required when one or more of the alternatives in the FS will have probable, significant, adverse environmental impacts. The EIS analyzes the probable significant adverse environmental impacts of each reasonable alternative to clean up the site consistent with MTCA and the reasonable measures that could reduce or mitigate those impacts (WAC 197-11-400). These impacts include short- and long-term impacts, direct and indirect impacts and cumulative impacts.

The EIS process is used to analyze alternatives and possible mitigation measures to reduce the environmental impacts of the proposal. The Draft FS/EIS was an integrated document, consistent with MTCA and SEPA regulations. Ecology decided to separate the Final FS from the EIS in order to expedite publication of the Final FS. A Draft Supplemental EIS is being prepared and will be published with the Draft Cleanup Action Plan for additional public review and comment. The final EIS will be published with the Final Cleanup Action Plan.

## **9.6 Preferred Alternative Selection**

Ecology will choose the cleanup action based on an analysis similar to that presented in this Section 8. The selected cleanup alternative must:

- Satisfy MTCA threshold requirements (Section 9.1)
- Be permanent to the maximum extent practicable (Section 9.2)
- Provide for a reasonable restoration timeframe (Section 9.3)
- Consider public concerns (Section 9.4)
- Minimize environmental impacts through alternative selection and mitigation (Section 9.5).

The selected cleanup alternative may or may not be one of the remedial alternatives presented in this Final FS. It may combine cleanup actions by zone in a manner that better satisfies MTCA requirements or it may use technologies that were retained (Appendix L) but not included in any of the remedial alternatives. For example, a final cleanup action based on SW3 might also include free product and soil excavation in the Levee Zone rather than just free product removal. As another example, a final cleanup action based on PB2 might include permeation grouting to solidify free product under buildings in the NW Developed Zone rather than excavation..

## 10 Preferred Remedial Alternative

Ecology makes the final selection of cleanup actions based on WAC 173-340-360. Alternative cleanup actions were developed in the draft Final FS that satisfy the following minimum, threshold requirements:

- Protect human health and the environment
- Comply with Cleanup Standards
- Comply with applicable state and federal laws
- Provide for compliance monitoring.

When selecting from among the cleanup action alternatives that satisfy the threshold requirements, Ecology considers the following additional criteria:

- Use permanent solutions to the maximum extent practicable
- Provide for a reasonable restoration timeframe
- Public and agency comments and concerns.

Formal public and agency comments were received on the Draft FS and Draft EIS in September and October 2003, formal comments from Ecology were received on the Preferred Remedial Alternative Memorandum on January 5, 2005, and informal comments have been received by BNSF through a series of technical workshops and open meetings with the public and agencies over an 18 month period prior to the publication of the Draft FS and Draft EIS, and BNSF has received additional input from the community and agencies since October 2003. This input was critical to BNSF in developing its preferred alternative for cleanup as Skykomish.

Other site-specific requirements specified in MTCA for the type of cleanup actions developed in this Final FS are:

- Requirements for Groundwater Cleanup Actions (WAC 173-340-360 (2)(c))
- Requirements for Soil Cleanup Actions for Residential Areas, Schools and Child Care Centers (WAC 173-340-360(2)(d))
- Requirements for Cleanup Actions that use Institutional Controls (WAC 173-340-360(2)(e) and 173-340-440)
- Requirement to prevent or minimize present or future releases and migration of hazardous substances (WAC 173-340-360(2)(f))
- Requirements for Cleanup Actions that use Dilution and Dispersion (WAC 173-340-360(2)(g))

- Requirements for Cleanup Actions that use Remediation Levels (WAC 173-340-360(2)(h)).

Following a discussion of the factors used in selecting the preferred alternative, this section presents a description of the preferred alternative,

## **10.1 Factors Influencing Selection**

Many factors were considered when developing BNSF's preferred remedial alternative. The analysis of alternatives in Section 9 of the FS above describes some new data that allowed additional analysis of the alternatives presented in the Draft FS/EIS and Draft Final FS. Public, Ecology and other agency comments were received on the Draft FS/EIS, and bench-scale testing of several technologies mentioned in the Draft FS/EIS were received and evaluated. Several of the most significant considerations that were used in developing BNSF's preferred alternative are detailed below.

- **Maintain historic character of town** – Many comments were received that expressed concern regarding the potential movement of historic structures to facilitate excavation. Other comments indicated that closing the school for cleanup actions, even if only for a single school year, might jeopardize the future viability of this important public institution and that closing the school would have serious social and economic consequences for Skykomish. The preferred remedy incorporates in situ remedial technologies where historic structures are present and offers a solution that avoids closing the school while classes are in session.
- **Restoration Timeframe** – Many comments expressed the need to achieve cleanup in as short a timeframe as possible. The preferred remedy includes rapid cleanup of the most significant potential human health and environmental exposures (the levee and shallow soil impacts) and overall provides short and reasonable restoration timeframes, particularly for the Aquatic Resource and Developed Zones of the site.
- **Socioeconomics** – A few comments expressed concern with the adverse economic consequences of contamination and a long and disruptive cleanup project. While MTCA and SEPA are not intended to directly address purely economic factors, MTCA and SEPA do require avoiding and mitigating adverse impacts on physical assets of communities and these assets are indirectly related to social and economic consequences of a project, including public and private buildings, streets and sidewalks, utilities such as water and power, open spaces, and natural areas. BNSF's preferred alternative was designed to remove as much contamination as possible, as quickly as possible, while

minimizing disruption to the commercial district of town, residential areas and public institutions. BNSF has also initiated direct discussions with the owners of property that is likely to be affected by BNSF's preferred cleanup plan in an effort to address purely economic issues.

- **Technology Testing Data** – Bench-scale testing results of several technologies have become available and are included by reference in this Final FS. These data, which were received earlier in 2004, suggest that enhanced bioremediation of contaminants will be effective in the NE Developed Zone. A significant change occurred following the bench-scale testing report while preparing the pilot test work plan for surfactant flushing. This more detailed analysis of surfactant flushing indicated that flushing is not sufficiently developed and proven to reliably recover the type of highly-viscous LNAPL found at the site.
- **Data Gaps** – Many comments suggested that additional data is needed from the site before Ecology selects a final cleanup action. Ecology has completed an investigation to obtain additional data from the flood control levee east of the 5th Street Bridge, between the river and the NE Developed Zone, within the former Maloney Creek channel, and at the USFS property south of the Old Cascade Highway. The new data will be incorporated into future documents, such as the cleanup action plan and remedial design work plans, as appropriate. In addition, BNSF's preferred alternative includes further characterization of the former Maloney Creek channel.

## 10.2 Description of Preferred Alternative

BNSF prepared a preferred alternative in May 2004 to present BNSF's then-current thinking regarding how cleanup can proceed at Skykomish consistent with the technical, legal and practical limitations (as expressed in the Draft Final FS and Draft EIS) as well as meet overall needs of the community (as expressed in verbal and written comments). BNSF's May 2004 preferred alternative also reflected technical and policy discussions BNSF and Ecology had over several years. BNSF revised its preferred alternative in late September 2004 based on new technical information about some of the remedial technologies that might have enhanced product recovery under buildings and structures. The preferred alternative presented in this document represents a slight modification from the September 2004 version in order to respond to the final TPH soil cleanup level (22 mg/kg) that Ecology issued on December 10, 2004. Thus, the preferred alternative in this section again represents BNSF's current thinking regarding technical, legal, practical and

community issues; however, Ecology will make the final selection of a cleanup action for Skykomish.

BNSF's preferred alternative addresses cleanup in Skykomish by "cleanup zones," as discussed throughout the Draft FS/EIS and final Draft FS. All cleanup zones will be addressed. Significant flexibility exists in implementing the work – a great deal of it can be phased over time to minimize overall disruption of the community. Figure 10-1 provides a schematic of the preferred remedy. The exact nature and extent of phasing will be determined during the remedial action design, with substantial input from elected officials with the Town and the School, affected property owners, and the rest of the community, as well as Ecology and other regulatory agencies. A proposed schedule and sequencing is provided as part of this section.

The principle cleanup standards used in developing BNSF's preferred alternative are:

- **Petroleum in Soil** – 22 mg/kg total EPH/VPH and NWTPH-Dx throughout the site to protect groundwater as a potential drinking water source and a current source of recharge to the river
- **Metals in Soil** – 20 mg/kg arsenic and 250 mg/kg lead soil to protect people from direct contact with surface soil
- **Petroleum in Groundwater** – 208 µg/L total EPH/VPH and NWTPH-Dx at the point of groundwater discharge to surface water to protect all beneficial uses of the Skykomish River
- **Petroleum in Sediment** – cleanup will remove sediments from an area defined by bioassay tests on aquatic organisms
- **Free Product** – cleanup will contain and remove all free product.

BNSF's preferred cleanup action for each cleanup zone will use these cleanup standards as well as remediation levels that were discussed previously.

### **10.2.1 Levee Aquatic Resource Zone**

The Aquatic Resource Zone along the river includes the area north of the existing subsurface barrier wall (along West River Road) and the south bank of the South Fork Skykomish River. The majority of this zone includes the floodwater control levee that was designed and built by the U.S. Army Corp of Engineers in 1951 and is currently maintained and managed by the King County Department of Natural Resources, Rivers Section.

The objectives of cleanup of this Zone are to stop free product discharges to the river, remove contaminated sediment that impacts aquatic receptors, and prevent dissolved petroleum in groundwater from contaminating surface water and sediment. In addition, the cleanup of this Zone should not jeopardize the public safety benefits of flood control and may provide an opportunity to enhance the existing river habitat that was impaired when the levee was originally constructed over 50 years ago.

The cleanup level for groundwater (208 µg/L total EPH/VPH and NWTPH-Dx) will protect sediment and surface water where groundwater discharges to the river. The cleanup level for sediment is based on bioassay testing. A remediation level of 3,400 mg/kg NWTPH-Dx will be used to define the extent of soil excavation necessary to protect groundwater.

BNSF's preferred remedy for this Zone includes:

- Excavating surface sediment along and within the South Fork of the Skykomish River at the base of the levee.
- Excavating and rebuilding portions of the levee to remove free product and contaminated soil.
- Long-term monitoring of groundwater quality to ensure compliance with the cleanup standard
- Contingent treatment of groundwater beneath the levee using enhanced biological treatment (e.g., air sparging).

The surface sediment removal area has been defined by bioassay testing. The area is estimated to be 440 feet long and 20 feet wide. This area will likely be removed along with the side slope of the Levee soil excavation. With excavation cut depths of 16 to 17 feet, the side slopes of the excavation will likely extend 24 to 26 feet into the river. A temporary cofferdam or similar barrier will be placed beyond this area, in-river, to prevent surface water from entering the excavation area.

Soil will be removed to address free product and to remove soil with concentrations above 3,400 mg/kg NWTPH-Dx. Excavation to this remediation level will remove soil above direct contact criteria and with the potential to impact groundwater to above the cleanup level. Additional details regarding the need to address power lines and construct a temporary access road west of the school were provided in Section 7.4.

An air sparging system will be installed in the Levee to address remaining dissolved phase groundwater impacts by enhanced biodegradation. This system includes vertical wells to inject the air and associated piping and blowers. This system is considered a contingency, since the preferred remedy

includes excavation of soil above 3,400 mg/kg NWTPH-Dx to 135 feet inland from the river into the NW Developed Zone, and calculations (Appendix S) indicate that groundwater will meet cleanup levels at the levee.

Excavated soil and sediment will be transported off-site to a licensed commercial landfill for disposal or reuse as daily cover. The existing subsurface barrier wall will either be preserved or it will be replaced; this will be determined during the remedial design.

Work performed at this Zone will have to satisfy substantive and procedural requirements of Section 404 of the Clean Water Act due to the presence of wetlands and navigable water, and Section 7 of the Endangered Species Act due to the presence of bull trout and salmon. For example, this will require work to be performed in the summer months during a “fish window,” which is typically July 1 to August 31. Habitat enhancement and mitigation will also be performed to maintain or improve riparian habitat; this will likely include a new design for the Levee and the use of native plantings on the reconstructed levee. King County has expressed an interest in being actively involved in the new design and in opportunities to enhance the existing habitat at the base of the levee. Work within this Zone that could impact threatened or endangered species in the river will be scheduled to occur during a single “fish window.”

Institutional controls will be required in this Zone to prevent exposure to soil, sediment and groundwater until monitoring confirms that the zone meets cleanup levels.

### **10.2.2 Former Maloney Creek Channel Aquatic Resource Zone**

The Former Maloney Creek Channel Aquatic Resource Zone includes the ditch and wetland areas located north of the Old Cascade Highway and associated storm water that drains through the former Maloney Creek channel. This Zone also includes contaminated sediment on the south side of the Old Cascade Highway, west of the culvert at Fifth Street. This Zone may be occasionally recharged by contaminated groundwater from the railyard during high water events. Coho salmon, a threatened species, have reportedly been observed in this drainage and the zone has several acres of wetlands. Cleanup in this zone will be closely coordinated with cleanup in the South Developed Zone and southern edge of the Railyard Zone, which are immediately south and north, respectively, of the Former Maloney Creek Channel Aquatic Resource Zone.

The objectives of cleanup in the former Maloney Creek channel are to prevent contaminated groundwater from discharging to surface water while preserving existing habitat. BNSF’s preferred alternative minimizes the need to physically remove contaminated sediments and disrupt the existing wetland habitat by focusing on restoration of the groundwater that recharges the zone

rather than excavating all the contamination (and the existing habitat) and then attempting to reconstruct the wetlands.

The following remediation levels have been developed for the Former Maloney Creek Channel Aquatic Resource Zone:

- Groundwater contaminated with petroleum will achieve 208 µg/L total EPH/VPH and NWTPH-Dx to protect surface water and sediment
- Soil contaminated with free product will be removed to protect groundwater
- Soil contaminated with petroleum will be removed within the upper 2 feet to protect people from direct contact with soil
- Additional soil contaminated with petroleum will be removed within the upper 1 foot to protect terrestrial ecological species from direct contact with soil.

The preferred alternative for this zone also includes hydrogeologic assessment of the area to refine our understanding of groundwater flow from the Railyard Zone and the extent to which it discharges to the former Maloney Creek channel. If groundwater flows south from the railyard, then the groundwater cleanup in the Railyard Zone will also cleanup groundwater in the Former Maloney Creek Channel Aquatic Resource Zone.

BNSF's preferred remedy for this Zone includes:

- Assessing groundwater, surface water and sediment quality in the vicinity of the wetland and the former Maloney Creek to refine our understanding of conditions beneath the former Creek channel and the former Creek channel's hydrologic connection to the surrounding area.
- Excavating soil or sediment hot spots within or adjacent to the wetland to remove free product and the most heavily-impacted soil in order to protect surface water quality. The locations that are currently candidates for excavation are near sample location 2A-B-8 and along the former creek channel that existed during railyard fueling operations; additional locations may be identified during the final assessment.
- Monitoring groundwater quality to determine whether excavation is protecting surface water, and implementing enhanced bioremediation of groundwater as a contingent remedy if, and as, needed.

- Placing a physical barrier at the west end of the culvert at 5<sup>th</sup> Street to temporarily prevent salmon from entering the former Creek Channel and redirecting them to suitable habitat in Maloney Creek.

The final assessment of groundwater, surface water and sediment quality will require a year to collect data and prepare a report. Hot spot removal can be performed during a single summer construction season. Excavated soil and sediment will be transported off-site to a licensed commercial landfill for disposal or reuse as daily cover. Monitoring will occur until a decision can be made regarding the need for enhanced bioremediation of groundwater. The current estimate for monitoring in this area following excavation is one to three years.

Institutional controls will be required to prevent direct contact exposure to soil and groundwater.

### **10.2.3 Northeast Developed Zone**

The NE Developed Zone includes residences, commercial buildings, streets, and public institutions such as Town Hall. The NE Developed Zone is affected by petroleum in groundwater and in soil where groundwater is first encountered (known as the “smear” zone). The petroleum in the NE Developed Zone contains a higher proportion of diesel fuel and is less viscous, more soluble, and more biodegradable than the petroleum present in the NW Developed Zone or the South Developed Zone. As a result, dissolved petroleum in groundwater in the NE Developed Zone is less closely associated with free product than other cleanup zones.

The cleanup level for groundwater in the NE Developed Zone (208 µg/L total EPH/VPH and NWTPH-Dx) will protect sediment and surface water where groundwater discharges to the river. In addition, the following remediation levels have been developed for this zone:

- Groundwater contaminated with petroleum will be treated to 477 µg/L total EPH/VPH to protect groundwater as a potential drinking water source.
- Soil containing free product will be excavated to help ensure the effectiveness of enhanced bioremediation as a groundwater and soil treatment technology. The free product at MW-21 appears to be more viscous than diesel and is likely heavier-end oil associated with a former oil column.
- Soil contaminated with petroleum above 2,900 mg/kg total EPH/VPH beneath buildings will trigger soil vapor, indoor air or ambient air quality monitoring. Where soil vapors consistently exceed applicable MTCA or other health-based criteria adjacent to

structures, then contingency measures can be implemented to assess and mitigate the accumulation of vapors in buildings.

Ultimately, all of the groundwater and soil will be treated to cleanup levels within this zone and institutional controls could then be removed.

BNSF's preferred remedy for this Zone includes:

- Excavating free product from under Railroad Avenue just north of the railyard (near MW-21) to a depth of about 15 to 16 feet below grade. This excavation is not anticipated to impact any structures.
- Enhancing biological treatment of soil and groundwater in the Railroad Avenue area to achieve direct contact soil cleanup levels, the groundwater remediation level protective of human health (477 µg/L total EPH/VPH) within the residential area, and groundwater cleanup levels protective of sediment prior to discharge to the river (208 µg/L NWTPH-Dx)

Following excavation, and pending biological treatment of soil and groundwater at depth, human health and the environment will be protected from direct contact with soil by about 8 feet of clean soil that already overlies the NE Developed Zone, from ingestion of groundwater by the availability of public water supply, and from contact with soil and groundwater at depth by institutional controls that provide a safe mechanism for managing contaminated soil and groundwater that may be removed during routine excavation activities in the zone.

The excavation work in the NE Developed Zone can be completed within one construction season. This work is not anticipated to impact any structures; however, utilities such as telephone and power may be temporarily impacted and a bypass road will be necessary to maintain access to the area east of the excavation. Excavated soil will be transported off-site to a licensed commercial landfill for disposal or reuse as daily cover. The enhanced biological treatment system within the zone will operate until soil and groundwater meet cleanup levels and remediation levels (approximately 5 to 10 years following excavation).

Institutional controls will be required to prevent exposure to soil and groundwater until monitoring confirms the zone meets cleanup levels.

#### **10.2.4 South Developed Zone**

The South Developed Zone includes two residences and involves petroleum composed of primarily of bunker C. The petroleum affects surface soil, smear zone soil and groundwater in a limited area. Free product present in MW-39 is more viscous than free product noted elsewhere on the site and appears to

be coincident with the original channel of Maloney Creek. Cleanup of this zone will be closely coordinated with cleanup of the adjacent Former Maloney Creek Channel Zone.

Soils contaminated with petroleum will be excavated to the remediation level (3,400 mg/kg NWTPH-Dx) in this zone due to its relatively small size, limited number of obstructions, and proximity to the wetland. Excavated soil will be transported off-site to a licensed commercial landfill for disposal or reuse as daily cover. This work can be completed within one construction season. Groundwater monitoring will continue for a period of 1 to 3 years to ensure that groundwater cleanup levels (208 µg/L total EPH/VPH) have been achieved to protect surface water and to protect groundwater as a potential future drinking water source. After the cleanup is complete and compliance monitoring is initiated, an empirical demonstration will show that soil excavation to a 3,400 mg/kg remediation level also results in groundwater meeting groundwater cleanup levels.

Long-term institutional controls will be required for soils with TPH concentrations between the site-specific cleanup level (less than 22 mg/kg total TPH/VPH and NWTPH-Dx)) and the remediation level (3,400 mg/kg NWTPH-Dx). Short-term institutional controls (less than 5 years) will be required to prevent exposure to groundwater until monitoring confirms the Zone meets cleanup levels.

### **10.2.5 Railyard Zone**

Most of the Railyard Zone has historically been used for industrial purposes and will continue as an industrial facility for the foreseeable future. It includes BNSF property with surface soil contaminated with metals and petroleum, and subsurface soil contaminated with petroleum. This Zone also includes portions of two properties immediately south of BNSF's property: surface soil is contaminated with metals on one of these properties (next to the library) and surface and subsurface soil is contaminated with petroleum on the second property. The Railyard Zone has an active main line with two sidings and two other active sidings south of the main line area. Both passenger and cargo trains use the main line and sidings; approximately one train per hour passes the site. Underground utilities, such as fiber optics, electrical, and signal lines, are present within the Railyard Zone. Any crossing of the rail lines for remediation system utilities and piping will require horizontal boring or jacking and boring.

The following remediation levels have been developed for this Zone:

- Free product will be recovered using trenches at BNSF's northern property boundary. The containment and removal of free product should ensure that groundwater discharging to the river will satisfy the cleanup level of 208 µg/L total EPH/VPH and NWTPH-Dx.

- Soil contaminated with metals will be excavated within the upper 2 feet to protect people from direct contact with soil and to prevent people from breathing contaminated dust from the railyard.

The preferred alternative for this Zone includes:

- Excavating the upper 2 feet of soil impacted with metals and TPH. PCBs have on occasion been detected in this same area and will also be removed. Clean fill will be placed over the excavated area.
- Installing product recovery trenches along Railroad Avenue, between the main rail lines and Railroad Avenue. The trenches will prevent further migration of free product north of the railyard and facilitate product recovery.

Each phase of this work (excavation, installing recovery trenches) will require one construction season. More detailed information on phasing of the cleanup is discussed later in this section. Excavated soil will be transported off-site to a licensed commercial landfill for disposal or reuse as daily cover.

Long-term institutional controls will be required on BNSF's property to prevent exposure to soil and groundwater. Short-term institutional controls will be required on the three properties adjacent to the railyard until cleanup levels are achieved in soil and groundwater.

## **10.2.6 Northwest Developed Zone**

The NW Developed Zone has multiple residences, commercial buildings, streets, and public institutions such as the school and community center. The zone is primarily affected by petroleum contaminants in the smear zone soil and groundwater, and the petroleum consists primarily of bunker C. This is the largest and most developed zone at the site and it presents several unique challenges. For example, the zone includes several historic structures that are important to the community, such as Maloney's General Store (now the Stove Shop), the Skykomish Hotel and the School. This zone also has a very shallow smear zone in some areas (approximately 2 feet below the surface). Finally, the zone is immediately upgradient of the Levee Aquatic Resource Zone such that cleanup in the NW Developed Zone will directly affect the scope, timing and nature of cleanup in the Levee Zone.

Free product is present in this zone between the Railyard Zone and the Levee Aquatic Resource Zone. The petroleum appears to originate in the vicinity of a former oil sump that was used to transfer bunker C from railcars to the aboveground 100,000 gallon oil storage tank on a 30-foot steel tower. This interpretation is based on free product thickness measurements, the location of oil seeps to the river, soil and groundwater data, known or suspected petroleum sources, lithologic controls and historic documents.

Interim actions have been performed in the NW Developed Zone that included:

- 1) Installing free product recovery wells along levee in 1996
- 2) Constructing a subsurface, free product barrier wall along the levee in 2001
- 3) Installing new recovery wells and upgrading existing wells in 2002.

The following remediation levels have been developed for the NW Developed Zone:

- Excavation is proposed to a remediation level of 3,400 mg/kg NWTPH-Dx for the area within 135 feet of the river. As discussed in Appendix S, this distance will ensure that groundwater discharging to the river satisfies the cleanup level.
- Free product will be contained and removed by a combination of excavation and recovery trenches. Excavation will occur as noted above and recovery trenches are proposed to remove free product from the area between the Railyard Zone and the excavated area.
- Soil contaminated with metals in the school yard, 4 residential yards, and at the Post Office within the upper 2 feet will be removed to protect people from direct contact with soil. Clean fill will be placed in the excavated areas.
- Soil contaminated with petroleum above 2,900 mg/kg total EPH/VPH beneath buildings will trigger vapor quality monitoring. Where soil vapors consistently exceed MTCA or other health-based criteria adjacent to structures, then contingency measures can be implemented to assess and mitigate the accumulation of vapors in buildings.

BNSF's preferred remedy for this Zone includes:

- Excavating the upper 2 feet of soil impacted by metals in private residential yards and on the school yard
- Excavating to a soil remediation level of 3,400 mg/kg NWTPH-Dx from within 135 feet of the river to a depth of 12 to 20 feet below grade.

- Installing four recovery trenches upgradient of the excavation area to minimize impacts to the commercial district and installing a recovery trench on the upgradient side of the excavation area.
- Replacing the Town's water supply lines in this Zone during excavation work to ensure over the long-term that groundwater does not enter the water supply.

The remedy is intended to avoid the temporary relocation or demolition of historic structures. Relocation and excavation beneath a few residences along West River Road is included to ensure that free product will not migrate toward the levee following levee cleanup and restoration. Excavation may also occur across 5<sup>th</sup> Avenue just south of the bridge such that this access point to the town will be impacted for part of one summer; due to the limited size of this excavation, additional investigation and information in the Final EIS will help Ecology and BNSF make the appropriate decision regarding this excavation, in consultation with the Town. Innovative approaches have been investigated to address free product remaining under structures in the commercial district of the zone. These approaches have showed some promise but they are highly innovative, not well tested and verified for viscous LNAPL, and expensive. BNSF intends to perform a review of viscous LNAPL removal technologies during successive 5-year reviews of the cleanup action in this Zone to investigate whether any new technology is developed that is effective and implementable. Construction activities associated with relocating these buildings and excavating free product is outside the commercial district to minimize impacts to the community.

Excavation can be completed in one or two construction seasons, including the temporary relocation of three to four homes. Excavated soil will be transported off-site to a licensed commercial landfill for disposal or reuse as daily cover. Recovery trenches can be completed in one construction season. Work will be phased and scheduled to minimize inconvenience to the Town, residents, businesses and the school.

Institutional controls will be required for an extended period of time until soil and groundwater achieve cleanup standards.

### **10.3 Project Schedule and Phasing**

A preliminary schedule and phasing is presented below. Remedial actions will start at the levee to eliminate impacts to the river as quickly as possible. The ability to perform this work is contingent on finalizing the Cleanup Action Plan and receiving permits and approvals from federal agencies to perform work in the river and the wetland. The preliminary proposed schedule and phasing is provided below.

### 10.3.1 Remedial Design

#### Remedial Design

Spring-Summer 2005

Remedial Design Investigations Start

Winter 2005/2006

Former Maloney Creek channel Assessment

#### Cleanup Actions

Summer 2006

Excavate impacted sediment and soil in the Levee Zone

Excavate shallow soil impacts in the NW Developed Zone and the Railyard

Summer 2007

Excavate in the NW Developed Zone to 135 feet from the river

Excavate Free Product in the NE Developed Zone

Summer 2008

Install product recovery trenches along Railyard and in the NW Developed Zone

Install enhanced biological treatment system in the NE Developed Zone

Summer 2009

Excavate the South Zone and the former Maloney Creek channel

### 10.4 Regulatory Evaluation of Alternative

The new preferred alternative (Figure 10-1) has been designed to satisfy both the MTCA “threshold” requirements and “other” MTCA requirements (WAC 173-340-360(2) and (3)). The threshold requirements state that the overall cleanup action must provide the following:

- Protection of human health and the environment
- Compliance with cleanup standards
- Compliance with applicable state and federal laws
- Provision for compliance monitoring

MTCA also defines other requirements that the cleanup action must satisfy. These are:

- Use of permanent solutions to the maximum extent practicable
- Provision for a reasonable restoration time frame
- Consideration of public concerns raised during the public comment period.

MTCA further identifies specific criteria that apply when certain types of cleanup actions are considered, such as restoration of groundwater, institutional controls, remediation levels, and cleanups in residential areas. This section describes how the new preferred alternative meets these criteria within the framework set forth in MTCA.

## 10.4.1 Threshold Requirements

All cleanup actions shall fulfill the “threshold requirements” as specified in WAC 173-340-360(2)(a). This section describes how the preferred remedy meets these threshold requirements.

### 10.4.1.1 Protect Human Health and the Environment

Cleanup levels that protect human health and the environment are provided in Section 5. A cleanup action that achieves cleanup levels at the point of compliance within a reasonable period of time is deemed to protect human health and the environment. Protection can be achieved by excavating all contaminated soil and sediments and attaining cleanup levels throughout the site, as described in alternative STD, or by removing free product and highly contaminated soils and then containing residual contamination in soil and groundwater and using institutional controls to minimize long-term exposure. The use of containment and institutional controls is acceptable under MTCA (WAC 173-340-360(2)(e)) as long as the overall cleanup action meets threshold and other requirements and the cleanup action does not “rely primarily on institutional controls.” The new preferred alternative protects human health and the environment by achieving cleanup levels at the point of compliance within a reasonable period of time.

#### Human Health

Section 5 demonstrates there are potential long-term risks to human health under the following conditions:

- Direct contact with soil containing concentrations of TPH (based on the sum of EPH/VPH data) greater than 2,130 mg/kg in the vadose zone and 2,765 mg/kg in the smear zone, arsenic above 20 mg/kg, and lead above 250 mg/kg. These numeric criteria are based on conservative exposure assumptions (i.e., a child ingesting 200 grams of soil per day for 6 years).
- The ingestion of groundwater or surface water containing greater than 477 µg/L TPH (based on the sum of EPH/VPH).
- Direct contact with oil seeps in the river during low water.

The preferred alternative includes the excavation and capping of all surface metals in soil in both the NW Developed and Railyard Zones. All other soil impacts are not present in surface soil and, therefore, require some form of excavation before there is human exposure. These intermittent exposures can be controlled with a high degree of certainty using institutional controls to limit direct contact exposures to subsurface soil and groundwater and ensure that contaminated soil and groundwater are safely managed during excavation

projects. Railyard workers regularly receive training regarding operational procedures that limit potential exposures and maintain institutional controls.

The preferred alternative includes the removal of free product and soil above 3,400 mg/kg NWTPH-Dx from the NW Developed Zone that is within 135 feet of the river, including the area of town where the vadose zone is thin and utilities may be located within impacted areas. This provides a more permanent means of protecting residents and utility or construction workers from being accidentally exposed to soil that presents a risk while working in yards or public rights-of-way, and a more permanent means of protecting the river. An additional layer of permanence and protectiveness will be achieved by excavating and replacing the town water line in the NW Developed Zone and placing it in a clean soil corridor.

The community currently has a public drinking water supply that is not at risk of contamination from the site. State and local institutional controls prohibit installation of wells within contaminated areas. These include the King County Board of Public Health, Public Water System Rules and Regulations (Title 12) and the Declaration of Covenant for Individual Water Supply, both managed by the Department of Health and Department of Ecology Minimum Standards for Construction and Maintenance of Wells, WAC 173-160. Even though human health risk related to groundwater is already controlled by the existing water supply system and institutional controls, MTCA generally requires that groundwater be cleaned-up to drinking water standards and that contaminated groundwater that may discharge to the river be controlled.

Human health cleanup levels for groundwater and surface water are based on restoring the water for use as drinking water. Off-railyard exceedances of the 477 µg/L groundwater level protective of human health are concurrent with free product (see Figure 3-11). The preferred alternative aggressively addresses free product in off-railyard areas to achieve the groundwater cleanup level in off-railyard areas in a relatively short timeframe, except for free product in the commercial district of the NW Developed Zone.

The Ecology-derived soil screening level for potential impacts to air quality is 2,900 mg/kg total EPH/VPH based on the 4-phase model. Previous air quality monitoring at the site demonstrated that there was no risk to human receptors in indoor and outdoor air. The preferred remedy includes additional air quality testing to verify that air quality levels are protective of human health.

## **Environment**

Section 5 demonstrates that risks to the environment under existing conditions at the site are the following:

- Sediment in the Skykomish River that failed bioassay tests due to the presence of product seeps.

- Groundwater discharging to the Skykomish River that may cause sediment to accumulate contaminants to levels that would present a risk to aquatic receptors. A groundwater TPH cleanup level of 208 µg/L total EPH/VPD and NWTDPH-Dx was developed using conservative assumptions related to groundwater-sediment interaction.
- Groundwater discharging to the surface water of the Skykomish River and the former Maloney Creek channel that would present a risk to aquatic receptors. A groundwater TPH cleanup level of 700 µg/L (NWTDPH-Dx) was developed based on WET testing bioassays on water column organisms.

The preferred alternative includes excavating free product and impacted soil at the levee to eliminate free product seeps to the river and providing contingent groundwater treatment if necessary to ensure that groundwater is clean before it discharges to the Skykomish River. With respect to the former Maloney Creek channel, it is not clear that groundwater above cleanup levels is discharging into the channel, although it may be inferred from the data. The preferred remedy includes excavating hot spot smear zone soil from the Railyard side of the wetland to protect surface water and shallow sediment removal to protect terrestrial and human receptors. Aggressive cleanup is proposed for the South Developed Zone, which is immediately upgradient of the former Maloney Creek channel and would be a source of groundwater that may discharge to the channel during certain times of the year. Active groundwater treatment within the former Maloney Creek channel is retained as a contingent remedy.

Based on bioassays, some sediment in the Skykomish River has been identified for cleanup. In addition, a correlation of the bioassay results with TPH concentrations produces a numeric cleanup level of 40.9 mg/kg NWTDPH-Dx (diesel + motor oil).

Environmental health will also be protected by minimizing disruption to the wetland. This is accomplished by focusing cleanup efforts on hot spots. It is well documented, and Ecology concurs, that it is more difficult to reestablish habitat than to retain existing habitat.

#### **10.4.1.2 Comply With Cleanup Standards**

Cleanup standards consist of both a cleanup level and a point of compliance where the cleanup level must be met (WAC 173-340-700). Per the regulation, “a cleanup level is the concentration of a hazardous substance in soil, water, air, or sediment that is determined to be protective of human health and the environment under specified exposure conditions.” For the preferred alternative, the standard points of compliance apply to soil and sediment. The cleanup standard applicable to groundwater in the preferred alternative is that

groundwater must achieve a cleanup level of 208 µg/L total EPH/VPH and NWTPH-Dx prior to discharging to the Skykomish River (i.e., surface water conditional point of compliance).

Only remedial alternative STD can achieve groundwater cleanup levels at the standard point of compliance (i.e., throughout the site, including the railyard and off-railyard properties). STD is considered a permanent groundwater cleanup action. Per WAC 173-340-360(2)(c)(ii), less permanent groundwater cleanup actions shall include “removal [of] free product consisting of petroleum and other light nonaqueous phase liquid (LNAPL) from the groundwater using normally accepted engineering practices” and “[g]round water containment...to the maximum extent practicable to avoid lateral and vertical expansion of the ground water volume affected by the hazardous substance.” The preferred alternative addresses these requirements through free product removal using excavation, barrier walls, and recovery trenches in off-railyard areas and barrier walls and recovery trenches on the railyard. Excavation, barrier walls, and recovery trenches are normal engineering practice for removing heavy, viscous free product.

Institutional controls are required to ensure compliance with cleanup standards and must be implemented in accordance with WAC 173-340-440. For the preferred alternative, long-term (10+ years) institutional controls are required to comply with cleanup standards. Institutional controls include restrictive covenants on individual properties and legal or administrative mechanisms. Restrictive covenants require the consent of the property owner of the property with contamination above cleanup levels to which the restrictive covenant is applied. Legal or administrative mechanisms include “zoning overlays, placing notices in local building department records or state lands records, public notices and education mailings.” State and local institutional controls already in place prohibit installation of wells within contaminated areas. Additional institutional controls (local ordinances and landowner agreements) can further limit exposure and provide a mechanism for BNSF (or the Town with technical and financial assistance from BNSF) to safely manage contaminated soil and water encountered during construction activities on private and public properties. Any of these institutional controls could be removed or modified once the cleanup is completed.

#### **10.4.1.3 Comply With Applicable Local, State and Federal Laws**

Several applicable local, state and federal laws have been incorporated into the cleanup level development process. These include the Sediment Management Standards (WAC 173-204). The State Environmental Policy Act (WAC 197-11-400) was also considered in developing the preferred alternative with alternatives, adverse impacts and mitigation measures disclosed and discussed in the Draft FS/EIS and subsequent environmental documents. Additional laws may apply to implementation of the cleanup

action. An example is Section 404 of the Clean Water Act that will require permitting and mitigation associated with cleanup actions that impact the South Fork Skykomish River or the wetland at the former Maloney Creek channel, and Section 7 of the Endangered Species Act requires consultation with federal resource agencies. The preferred alternative has been devised and will be designed to comply with applicable local, state and federal laws.

#### **10.4.1.4 Provide for Compliance Monitoring**

Compliance monitoring is not a cleanup element that is described in detail during the FS process. These provisions are better developed in the Cleanup Action Plan and detailed Compliance Monitoring Plans are developed during engineering design of the cleanup action. Compliance Monitoring Plans will provide for a monitoring program that ensures that cleanup levels are obtained and will include provisions for contingent remedies should any part of the new preferred alternative fail to meet cleanup standards. A brief description of the compliance monitoring program is discussed in Section 10.5.

#### **10.4.2 Use Permanent Solutions to the Maximum Extent Practicable**

The first of three “other requirements” for selection of cleanup actions under MTCA is the use of permanent solutions to the maximum extent practicable. The procedure for determining whether a cleanup action uses permanent solutions to the maximum extent practicable is provided in WAC 173-340-360(3). This section presents a “disproportionate cost analysis” to compare the relative costs and benefits of a permanent alternative with the other alternatives being considered. Costs are disproportional to benefits if the incremental cost of the permanent alternative exceeds the incremental benefit achieved by that permanent alternative with the additional cost. The analysis may be quantitative or qualitative. The analysis begins by ranking alternatives from the most permanent to the least permanent. Once alternatives are ranked from the most permanent to the least permanent, they are evaluated based on seven criteria in WAC 173-340-360(f).

A “permanent cleanup action” achieves cleanup standards without further action at the site, such as long-term monitoring, maintenance or institutional controls (WAC 173-340-200). In the draft Final FS and in this document, the measure used to quantify permanence is termed “equivalent soil volume” but it is a relative measure of petroleum mass removed in each alternative rather than volume. An alternative that treats or removes a greater equivalent soil volume (or mass of petroleum) than other alternatives may be considered more permanent because it represents a larger reduction in the volume of hazardous substances at the site and a reduced need for long-term monitoring, maintenance or institutional controls. The remedial alternatives are ranked in Figure 10-2 from the most permanent (STD) to the least permanent (No

Action). The new preferred alternative is ranked seventh in level of permanence.

#### **10.4.2.1 Protectiveness**

Protectiveness of human health and the environment includes the degree to which existing risks are reduced, time required to reduce risk at the site and attain cleanup standards, on-site and off-site risks resulting from implementing the alternative, and improvement of the overall environmental quality.

The discussion regarding protection of human health and the environment in Section 10.1.1 demonstrates of how the preferred remedy protects human health and the environment. The preferred remedy was designed to aggressively address possible human health risk associated with exposure to impacted surface soil. The preferred alternative also includes replacement of the water service line in the NW Developed Zone to ensure that the water supply system is not impacted. While human health risk associated with consumption of groundwater is already controlled through institutional controls, the preferred alternative aggressively addresses free product in the developed zones to achieve the groundwater concentration protective of human health (477 µg/L total EPH/VPH) in most off-railyard areas.

The preferred alternative provides the greatest level of environmental protectiveness by addressing soil and sediment in the former Maloney Creek channel and by addressing soil, sediment, and free product at the Levee. The preferred remedy also minimizes impacts to the wetland while addressing risk issues, thereby contributing to overall environmental quality.

The preferred remedy places a priority on addressing the most significant risks in the shortest period of time. Specifically, the preferred remedy includes addressing the most significant environmental impact by proposing to excavate the levee and the surface metals impacts.

The preferred remedy addresses implementation risks by minimizing the amount of excavation within portions of the town. This occurs through the use of recovery trenches in the commercial portion of town. The excavation of free product and impacted soil closer to the river provides more certainty that exposure risks are controlled in areas closest to the sensitive receptors associated with the river.

Based on the description of protectiveness, all of the alternatives were ranked using a scoring system. The scoring system is intended to take into account all of the criteria associated with protectiveness listed in MTCA, including the degree to which existing risks are reduced, time required to reduce risk at the facility and attain cleanup standards, risks resulting from implementing the alternative and improvement of the overall environmental quality. The results

are summarized in Table 10-1. The results illustrate that for protectiveness, the preferred alternative receives a ranking of 9.25, slightly below the 10 ranking for alternatives PB4, PB5, and STD.

#### **10.4.2.2 Permanence**

Permanence was discussed earlier and the relative permanence of the remedial alternatives was illustrated in Figure 10-2. The preferred remedy is the seventh most permanent remedy considered for the site. The permanence associated with the preferred remedy is focused more on the Aquatic Resource Zones than the Developed Zones and the Railyard.

#### **10.4.2.3 Cost**

Figure 10-3 indicates the cost for each alternative with the alternatives ranked by level of permanence. Detailed cost estimates are provided in Appendix N. The largest cost elements are associated with cleanup of the NW Developed Zone, Levee Aquatic Resource Zone, and the Railyard Zone. Cleanup of the other three zones combined contribute on the order of 15 percent or less of total costs. The total project costs range from less than \$10 million to almost \$80 million.

Figure 10-4 illustrates the cost to achieve the increasing levels of permanence. Lower unit costs (total cost divided by total equivalent soil volume) indicate increased cost-effectiveness of the remedial alternative with respect to equivalent soil volume removal or treatment where equivalent soil removal volumes are used as a surrogate for contaminant mass removal and permanence.

#### **10.4.2.4 Effectiveness Over the Long-Term**

Long-term effectiveness includes “the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time hazardous substances are expected to remain on-site at concentrations above cleanup levels, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes.”

MTCA suggests the use of the following hierarchy of cleanup action components in descending order of long-term effectiveness:

- 1) Reuse or recycling
- 2) Destruction or detoxification
- 3) Immobilization or solidification
- 4) On- or off-site disposal
- 5) On-site isolation or containment
- 6) Institutional controls.

The remedial technologies in the proposed remedial alternatives fit this hierarchy as follows:

- 1) Reuse or recycling (free product skimming or trenches with free product recovery and recycling)
- 2) Destruction or detoxification (natural attenuation and enhanced bioremediation)
- 3) Immobilization or solidification (none)
- 4) Excavation (requires off-site disposal)
- 5) Containment (soil and groundwater managed in place)
- 6) Institutional controls (soil and groundwater managed if and when excavated for other projects).

Equivalent soil volumes were calculated for each cleanup action component for each alternative (see Appendix N). The volumes were then divided by the hierarchy number and summed for each alternative to derive a normalized equivalent soil volume. The higher normalized equivalent soil volume suggests a higher level of long-term effectiveness. This approach was used to score the alternatives from 0 to 5 points. The other 5 points were scored based on site remediation activities that were most likely to contribute to the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time that hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes. The resulting scores for long-term effectiveness are provided in Table 10-1. The preferred alternative ranks sixth, behind SW4, PB3, STD, PB5, and PB4.

#### **10.4.2.5 Management of Short-Term Risks**

Impacts from remedial action implementation include vehicle traffic, temporary relocation of residences/structures, odor, open excavations, and noise, dust and safety concerns associated with extensive heavy equipment activity. The greatest short-term risk to human health is related to safety and general construction activity. As a result, the short-term risks to human health would be greatest for the more permanent alternatives. In all cases, similar measures would be taken to manage risk such as fencing, signage, dust controls, and traffic control.

With respect to short-term risks to the environment, more aggressive remedies in the Aquatic Resource Zones present a greater short-term risk to the environment. So, similar to human health risks, the short-term risks to the environment would be greatest for the more permanent alternatives. In all

cases, similar measures would be taken to manage risk such as temporary dams to prevent surface water discharges, angle boring to minimize drilling in sensitive areas, and scheduling work to avoid sensitive species during critical stages.

Based on the description of short-term risk, all of the alternatives were ranked using a scoring system. The results are summarized in Table 10-1. The preferred alternative received a moderate score, similar to the other more aggressive remedies. Overall the preferred alternative was ranked sixth.

#### **10.4.2.6 Technical and Administrative Implementability**

Three major administrative concerns with the remedial alternatives are institutional controls, permitting, and relocating residents, businesses, transportation facilities and public facilities such as the school. The preferred alternative requires long-term institutional controls on off-railyard properties where soil and/or groundwater will remain above cleanup levels for extended periods of time. The preferred alternative is rather aggressive in that excavation beneath properties abutting the river (requiring movement of several homes and buildings) is included, although the extent of excavation is limited to minimize disruption to the community. The use of institutional controls diminishes the administrative implementability, generally in proportion to the number of properties requiring some form of institutional control and the length of time these controls must be enforced.

The second administrative implementability issue relates to permitting and mitigating adverse impacts from cleanup actions at the Levee and the former Maloney Creek channel. Permits are required from the US Army Corps of Engineers under Section 404 of the Clean Water Act, and the Endangered Species Act requires the Corps to consult with NOAA-Fisheries and the U.S. Fish and Wildlife Service. Permitting of environmental cleanup activities under this process is expected to take one to two years. The preferred remedy would likely require this permit. In addition, invasive work on or in the Levee requires coordination with King County to ensure the structural integrity of the Levee is not compromised.

Finally, the more aggressive remedies necessarily involve administrative and technical challenges associated with work around and under buildings and facilities such as the school, the community center, residences, businesses, the main rail line, streets and utilities. The use of excavation has been minimized in the preferred alternative to reduce these technical and administrative challenges. Temporary dwellings will be required for only a small number of residents due to excavation. Businesses should not be disturbed, although the community center may have to close for one summer.

The preferred alternative ranks seventh for technical and administrative implementability, due to the triggering of in-water work permit requirements, and the remaining need for institutional controls.

#### **10.4.2.7 Consideration of Public Concerns**

The preferred alternative incorporates concerns raised during the public comment process for the Draft FS/Draft EIS as well as concerns that have been raised during technical workshops sponsored by BNSF over the past 2 years. These concerns have been incorporated into development of the preferred remedial alternative to the extent possible while still providing a remedy that satisfies the MTCA threshold requirements. Additional public comment and community involvement will occur during remedial design and when determining how to phase the cleanup activities within each cleanup zone.

#### **10.4.2.8 Permanence to the Maximum Extent Summary**

As noted at the beginning of this section, the analysis of whether an alternative is permanent to the maximum extent practicable involves the comparison of the alternatives based on the seven evaluation criteria as described above. The goal is to determine whether the incremental cost of an alternative is disproportionate to the incremental benefit relative to the lower cost alternative (WAC 173-340-360(e)(i)). A systematic approach was developed to quantify the relative benefit of the alternatives. The total benefit of each alternative was calculated as the sum of ratings for five of the evaluation criteria:

- 1) Protectiveness
- 2) Permanence
- 3) Effectiveness over the long-term
- 4) Management of short-term risks
- 5) Technical and administrative feasibility.

Public concerns were based on the public comment received on the Draft FS/Draft EIS and these were incorporated in the development of the preferred remedy. Cost is part of the analysis to determine if the incremental cost of an alternative is disproportionate to the incremental benefit relative to the lower cost alternative. The benefit ratings are provided in Table 10-1 and Figure 10-5 illustrates these benefit ratings and alternative costs.

To further evaluate the ratings, benefit was plotted versus cost in Figure 10-6. Where a line between two alternatives is steeper (closer to vertical), there is greater incremental benefit per incremental dollar expended. This figure indicates that SW3, PB2, and the preferred alternative are alternatives where the cost of proceeding to the next more costly alternative outweighs the benefits. SW3 was not selected as BNSF's preferred alternative since it does not aggressively address impacts in the Aquatic Resources Zones or the NE

Developed Zone. The preferred alternative provides greater benefit than PB2 for a similar cost, indicating that the cost is disproportionate to benefit for PB2. In addition, PB2 includes complete removal of free product in the NW Developed Zone, which was deemed not likely to be acceptable to the community.

MTCA also states that the most practicable permanent alternative shall be the “baseline cleanup action” against which other alternatives are compared (WAC 173-340-360(e)(ii)(B)). To evaluate the alternatives using this criterion, the data was further evaluated. STD was considered the most practicable permanent alternative since it had the highest benefit rating. Figure 10-7 illustrates the percentage incremental benefit and percentage decrease in cost of each alternative versus STD. This analysis indicates that the preferred alternative is permanent to the maximum extent practicable, followed by PB4, PB2, SW4, and PB3.

### **10.4.3 Provide for a Reasonable Restoration Timeframe**

The second of three “other requirements” for selection of cleanup actions under MTCA is a reasonable restoration timeframe. Restoration timeframe is the time it takes to meet cleanup standards (i.e., to meet all cleanup levels in all media at all points of compliance). A cleanup action can meet cleanup standards through the use of treatment, removal or containment, or some combination of these three approaches. Each alternative relies on removal of free product and restoring groundwater before it discharges to surface water. The PB alternatives rely on containment and institutional controls for soil in off-railyard areas while the SW alternatives rely on containment and institutional controls for both soil and groundwater in off-railyard areas.

Estimates of time to remove free product and to restore groundwater and cleanup soil were generated for each zone and remedial alternative. Since detailed phasing was not considered for each alternative and restoration timeframes are provided separately for each cleanup zone, the restoration timeframes provided in this section do not account for the additional time required to phase cleanup in the different zones. These estimates assume that containment and institutional controls can be established for off-railyard areas for soil and groundwater. Figures 10-8 through 10-10 illustrate the estimated restoration timeframes. These charts present the mid-point from estimated ranges, as follows:

- “4 years” represents a 3 to 5 year range
- “8 years” represents a 5 to 10 year range
- “15 years” represents a 10 to 20 year range
- “25 years” represents a 20 to 30 year range
- “40 years” represents greater than 30 years.

The procedure for determining whether a cleanup action provides for a reasonable restoration timeframe is provided in WAC 173-340-360(4). The nine factors used to determine whether a cleanup action provides for a reasonable restoration timeframe are provided in the rule and include:

- 1) Potential risks posed by the site to human health and the environment
- 2) Practicability of achieving a shorter restoration timeframe
- 3) Current use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site
- 4) Potential future use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site
- 5) Availability of alternative water supplies
- 6) Likely effectiveness and reliability of institutional controls
- 7) Ability to control and monitor migration of substances from the site
- 8) Toxicity of hazardous substances at the site
- 9) Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the site or under similar conditions.

The rule (WAC 173-340-360(4)(c)) also states that: “a longer period of time may be used for the restoration timeframe for a site to achieve cleanup levels at the point of compliance if the cleanup action selected has a greater degree of long-term effectiveness than on-site or off-site disposal, isolation, or containment options.”

Figure 10-8 indicates that free product will be removed from all off-railyard areas within two years for the preferred alternative, except for the NW Developed Zone. Free product will have been excavated from the area of the NW Developed Zone closest to the river where it poses a risk to river sediment. The remaining free product will be contained and removed using trenches in the commercial and historic district. Free product will also remain on the railyard for an extended period of time because the free product on the railyard does not pose a significant risk to human health or the environment.

Figures 10-9 and 10-10 indicate that the preferred alternative achieves cleanup standards for soil and groundwater within two years in the Levee, Former

Maloney Creek Channel, and South Zones. The Aquatic Resource Zones are the drivers of the groundwater cleanup levels that will be achieved by the preferred remedy. The soil and groundwater restoration timeframes for the NE Developed Zone are 5 to 10 years where soil and groundwater impacts are present beneath 8 feet of clean soil and where enhanced biodegradation is expected to be effective. Free product will have been excavated from the area of the NW Developed Zone closest to the river where it poses a risk to river sediment and the remaining soil and groundwater impacts will be effectively contained. Residual impacts on the Railyard will not pose a risk to human health and the environment. The use of the preferred alternative rather than more aggressive remedies avoids significant disruption to the community. Residual impacts in the NE Developed Zone, the NW Developed Zone, and the Railyard Zone do not pose a significant risk to human health and the environment, water is provided by the town, and institutional controls are likely to be effective and reliable.

#### **10.4.4 Consider Public Concerns**

The third of the three “Other Requirements” in MTCA is to consider public concerns. The public comment process included review of the Draft FS/Draft EIS. These public comments were used in the development of the preferred remedy.

#### **10.4.5 MTCA Site-Specific Requirements**

Site-specific requirements for MTCA cleanup actions were listed at the beginning of this Section. The means by which the preferred remedy satisfies these requirements is presented below.

##### **10.4.5.1 Requirements for Groundwater cleanup actions (WAC 173-340-360 (2)(c))**

The groundwater cleanup action included in the preferred remedy is a nonpermanent cleanup action. When a nonpermanent cleanup action is used, MTCA requires treatment or removal of the source and the use of groundwater containment. The preferred remedy satisfies these requirements by removing free product from most off-railyard areas in a short timeframe, and by containing and collecting free product remaining in the NW Developed Zone and on the railyard. Removal of free product achieves human health criteria in groundwater, and enhanced bioremediation will be used as a contingent remedy at the Levee and/or the Former Maloney Creek Zone, if monitoring shows that it is necessary to treat groundwater before it discharges to surface water.

#### **10.4.5.2 Requirements for Soil Cleanup Actions for Residential Areas, Schools and Child Care Centers (WAC 173-340-360(2)(d))**

MTCA requires that soils with hazardous substance concentrations that exceed cleanup levels be treated, removed, or contained. The preferred remedy includes aggressive removal of free product and shallow soil impacts from all residential areas and the school in Skykomish. All soil impacts will be removed from the South Developed Zone. All soil impacts will be addressed by enhanced bioremediation in the NE Developed Zone and in the interim an 8-foot clean soil cap is present. In the NW Developed Zone, a 2-foot clean soil cap will be used to contain soil impacts.

#### **10.4.5.3 Requirements for Cleanup Actions that use Institutional Controls (WAC 173-340-360(2)(e) and 173-340-440)**

Cleanup actions that use institutional controls shall satisfy the threshold and other requirements, shall use institutional controls to demonstrably reduce risk, and shall not rely primarily on institutional controls where it is technically possible to implement a more permanent cleanup action.

The preferred alternative satisfies the threshold and other criteria defined in MTCA, as discussed earlier in this section. Institutional controls are used primarily on the railyard where they are more effective and reliable at reducing risk but they will also reduce risk in both the NE and NW Developed Zone by preventing direct contact with soil and ingestion of groundwater. The preferred remedy is an aggressive remedy that includes substantial removal and treatment of soil and groundwater. Institutional controls are only used where they are effective and reliable or where the disruption associated with a more permanent cleanup would not substantially reduce risk to human health and the environment.

#### **10.4.5.4 Requirement to prevent or minimize present or future releases and migration of hazardous substances (WAC 173-340-360(2)(f))**

Cleanup actions shall prevent or minimize present and future releases and migration of hazardous substances in the environment.

The preferred remedy includes aggressive cleanup actions in off-railyard areas. The remedy also includes the physical containment of free product on the railyard and enhanced bioremediation of groundwater as a contingency, if monitoring shows that it is necessary to achieve groundwater cleanup levels before groundwater discharges to surface water.

#### **10.4.5.5 Requirements for Cleanup Actions that use Dilution and Dispersion (WAC 173-340-360(2)(g))**

Cleanup actions shall not rely primarily on dilution and dispersion unless the incremental costs outweigh the incremental benefits of active remedial measures.

The preferred remedy does not rely on dilution or dispersion for any cleanup zone on the site. In off-rail yard areas, sources of petroleum, such as free product, are aggressively addressed and ongoing treatment of residual impacts is addressed using enhanced bioremediation, as necessary.

#### **10.4.5.6 Requirements for Cleanup Actions that Use Remediation Levels (WAC 173-340-360(2)(h))**

Cleanup actions that use remediation levels require a determination that a more permanent cleanup action is not practicable based on a disproportionate costs analysis and the selected alternative must meet the threshold and other requirements specified in MTCA.

The disproportionate cost analysis for the preferred remedy was presented in Section 10.1.2. The analysis demonstrated that the preferred alternative is permanent to the maximum extent practicable. In addition, Sections 10.1.1 and 10.1.3 through 10.1.5 demonstrate that the preferred alternative satisfies the threshold and other criteria.

#### **10.4.5.7 Types, Levels, and Amounts of Hazardous Substances Remaining On Site (WAC 173-340-380(1)(ix))**

A Cleanup Action Plan must include a description of the types, levels, and amounts of hazardous substances remaining on site and the measures that will be used to prevent migration and contact with those substances. Ecology requested that the types, levels, and amounts information be included in the FS. Figure 10-11 presents this information for the preferred alternative. The figure includes a map of remaining contamination after active remediation where active remediation includes excavation and enhanced bioremediation when used for treatment rather than containment. A graph is also provided to show what percentage of remaining impacts will be recovered or degraded over time. The preferred alternative data may be compared with similar data provided for the other alternatives in Figures 8-1 to 8-10. It should be noted that the graphs were based on gross assumptions that allow for comparison between alternatives but are not intended to indicate actual degradation rates or timeframes.

## **10.4.6 SEPA**

The Draft FS and Draft EIS were integrated into a single document that described alternatives, significant adverse environmental impacts and reasonable mitigation measures consistent with SEPA (WAC 197-11-400), as well as MTCA. The adverse impacts described in an EIS include short- and long-term impacts, direct and indirect impacts and cumulative impacts.

The information in the Draft EIS and the public and agency comments received in response to the Draft EIS were used by BNSF in developing the preferred remedy presented in this Draft FS. For example, specific mitigation measures include standard construction BMPs for the protection of soil and water, air quality, fish and wildlife, vegetation, aesthetic and historical resources, human health and public property, including construction timing restrictions, implemented under all alternatives. In addition, replacement of excavated soil with comparable material mitigates for soil impacts in the developed areas and the aquatic resource zones. Replacement of septic systems can mitigate the impact to the leach fields. Due to Department of Health requirements, leach field replacement may have to occur using a centralized system placed in native soil. Mitigation measures focusing on appropriate timing of work in the riverfront area mitigates against risk of flooding and hydrologic impacts. Compensatory wetland mitigation would be detailed in a Wetland Mitigation Plan to off-set impacts to the former Maloney Creek channel wetlands consistent with the requirements of the Skykomish Critical Areas Ordinance and the U.S. Army Corps of Engineers regulations. Impacts on land use from contaminated soil and groundwater can be mitigated by maintaining a clean soil cover at the surface, continuing to make public water available, and implementing institutional controls which will limit exposure and provide a mechanism for BNSF (or the Town with technical and financial assistance from BNSF) to safely manage contaminated soil and water encountered during construction activities on private and public properties.

Unavoidable significant impacts associated with the preferred alternative include:

- Relatively high noise levels in town during working hours
- Increased truck traffic in the town of Skykomish
- Increased truck traffic on U.S. Highway 2
- Road closures
- Effects to public services, housing, historic structures, and aesthetics
- Temporary loss of salmonid habitat.

Before Ecology makes a final decision on a cleanup plan, a Final EIS will be issued.

### **10.4.7 Preferred Alternative Selection**

Ecology will choose the cleanup action based on an analysis similar to that presented earlier in Section 10. The selected cleanup alternative must:

- Satisfy MTCA threshold requirements
- Be permanent to the maximum extent practicable
- Provide for a reasonable restoration timeframe
- Consider public concerns
- Minimize environmental impacts through alternative selection and mitigation.

The selected cleanup alternative may or may not be one of the remedial alternatives presented in this Draft FS, including the preferred alternative. It may combine cleanup actions by zone in a manner that better satisfies MTCA requirements or it may use technologies that were retained (Appendix M of the Draft FS) but not included in any of the remedial alternatives. The selected cleanup alternative will be presented by Ecology in the Cleanup Action Plan.

Section 10.4 demonstrates that the preferred remedy proposed herein satisfies the MTCA criteria listed above and also considers the environmental impacts that will be addressed in the EIS.

## **10.5 Compliance Monitoring Plan**

The preferred remedial alternative includes all phases of compliance monitoring, including protection, performance and confirmational monitoring. Compliance monitoring requirements are provided in WAC 173-340-410. This section provides an overview of the compliance monitoring concepts that will be applied to the preferred remedy. A compliance monitoring plan will be prepared as part of the remedial design process.

Protection monitoring ensures that human health and the environment are protected during implementation of the cleanup alternative. Examples of protection monitoring include: 1) monitoring air quality for dust during excavation and hauling activities; and 2) monitoring surface water quality downstream of sediment removal activities to ensure that turbidity is not affecting water quality.

Performance monitoring is used to determine if a cleanup action has achieved performance standards. The primary performance standards are cleanup levels and remediation levels, although they can also include construction quality control monitoring or monitoring for compliance with permit conditions.

Confirmational monitoring is used to determine the long-term effectiveness of the remedy once performance monitoring has determined that performance standards have been achieved. Through the remainder of this section performance and confirmational monitoring approaches will be discussed assuming similar approaches.

### 10.5.1 Compliance with Cleanup Standards

The cleanup standards used in developing the preferred alternative were:

- **Soil** – 22 mg/kg total EPH/VPD and NWTPH-Dx throughout the site based on the protection of sediment from dissolved groundwater from leaching from soil
- **Groundwater** – 208 µg/L total EPH/VPD and NWTPH-Dx at the point of groundwater discharge to surface water to protect sediment in the South Fork Skykomish River from recontamination due to groundwater
- **Sediment** – cleanup will occur for the area defined based on bioassay failures.

BNSF proposes to use an empirical demonstration in accordance with WAC 173-340-747(9) to demonstrate compliance with the soil cleanup level. The empirical demonstration will be performed at wells within the levee and at the downgradient extent of the dissolved plume in the NE Developed Zone. Remediation levels have been incorporated into the preferred remedy to ensure that the remedy is protective of human health and the environmental through all pathways.

Compliance with the groundwater cleanup level will be determined at the same locations as proposed for the empirical demonstration of compliance with the soil cleanup level.

The area for removal of sediment has been pre-defined based on bioassay testing. Following removal and backfill of these sediments, groundwater compliance monitoring, discussed above, will be used to verify long-term compliance with cleanup levels.

### 10.5.2 Compliance with Remediation Levels

The preferred remedy incorporates several remediation levels, as follows:

- Groundwater will be treated to achieve the 477 µg/L total EPH/VPH to protect groundwater to human health standards in the NE Developed Zone.
- Free product will be removed by excavation. Excavation is proposed for NE, NW and South Developed Zones and the former Maloney Creek channel.
- Soil exceeding levels protective of direct contact and empirically protective of leaching to groundwater (3,400 mg/kg NWTPH-Dx) in the smear zone will be excavated at the Levee, within 135 feet of the River in the NW Developed Zone, and in the South Developed Zone.
- Soil exceeding levels protective of direct contact will be achieved within the upper 2 feet of soil in residential yards in the NW Developed Zone and in the former Maloney Creek channel.
- Soil exceeding levels protective of terrestrial ecological receptors will be achieved within the upper 1 foot of soil in residential yards in the NW Developed Zone and in the former Maloney Creek channel.
- Soil exceeding levels protective of air (vapor) quality for human health will be achieved in the upper 15 feet in the NE and NW Developed Zones.

These remediation levels are grouped below to simplify the discussion of compliance monitoring.

#### **10.5.2.1 Soil Protective of Direct Contact**

Compliance with remediation levels based on direct contact will be evaluated during performance monitoring. Remediation levels that are included in this category are:

- Soil exceeding levels protective of direct contact in the smear zone
- Soil exceeding levels protective of direct contact will be achieved within the upper 2 feet of soil.
- Soil exceeding levels protective of terrestrial ecological receptors will be achieved within the upper 1 foot of soil.

Compliance with these remediation levels will be achieved using excavation. Performance monitoring of an excavation typically includes sampling of excavation sidewalls and bottom at an appropriate frequency to confirm that

the remediation level has been achieved. Excavation in the NW Developed Zone will occur for metals and petroleum impacts. Excavation in the former Maloney Creek channel and the South Developed Zone would occur due to the presence of petroleum.

#### **10.5.2.2 Soil Protective of Leaching to Groundwater**

Compliance with remediation levels based on leaching to groundwater will be evaluated during both performance and conformational monitoring. The remediation level included in this category is:

- Soil empirically protective of leaching to groundwater (3,400 mg/kg NWTPH-Dx) in the smear zone will be excavated.

Compliance with this remediation level will be achieved using excavation. Performance monitoring of an excavation typically includes sampling of excavation sidewalls and bottom at an appropriate frequency to confirm that the remediation level has been achieved. Excavation will occur at the Levee, within 135 feet of the River in the NW Developed Zone, and in the South Developed Zone.

For confirmational monitoring when soil is excavated to this remediation level, the compliance monitoring will include sampling wells and analyzing for NWTPH-Dx. This sampling will be used to determine if excavation to the remediation level achieves the groundwater cleanup level.

#### **10.5.2.3 Soil Protective of Air Quality**

Compliance with remediation levels based on protecting air quality will be evaluated during performance monitoring. The remediation level that is included in this category is:

- Soil exceeding levels protective of air quality for human health will be achieved between the bottom of the smear zone and ground surface.

Ecology developed a soil screening level of 2,900 mg/kg total EPH/VPH based on the 4-phase model.

Performance monitoring is proposed to demonstrate that existing and post-cleanup soil quality is protective of human health, consistent with WAC 173-340-745(5)(c)(iv)(B)(II). This monitoring will be used to demonstrate that air concentrations do not exceed levels that will be established consistent with WAC 173-340-750. Air quality concentrations above protective levels will trigger contingent actions.

#### 10.5.2.4 Free Product Removal

Compliance with remediation levels for excavating free product will be evaluated during performance monitoring and confirmational monitoring. The remediation level that is included in this category is:

- Free product will be removed by excavation and recovery trenches. Excavation is proposed for NE and NW Developed Zones and the former Maloney Creek channel. Recovery trenches are proposed for the NW Developed Zone and between the NE Developed Zone and upgradient impacts in the Railyard Zone.

When free product is removed by excavation during low water conditions, the primary focus will be removing the heavily impacted soil associated with the free product area. Free product will be removed from groundwater at the base of the excavation and a soil concentration level will be used to guide the extent of excavation. A preliminary evaluation of NW Developed Zone soil concentrations indicative of free product indicates that a concentration of about 10,000 to 15,000 mg/kg NWTPH-Dx (diesel plus motor oil) in the smear zone above the water table elevation or a concentration of greater than 20,000 mg/kg NWTPH-Dx (diesel plus motor oil) at or below the water table indicates the presence of free product. A separate analysis will be needed to develop the appropriate concentrations in the NE Developed Zone.

For confirmational monitoring when free product is excavated or recovered in trenches, the compliance monitoring will include gauging of wells for the presence of free product. This gauging will be used to determine if there is a separate, distinct layer indicative of free product and it will also be used to demonstrate compliance with the nonaqueous phase liquid limitation (WAC 173-340-720(7)(d)).

#### 10.5.2.5 Groundwater Protective of Human Health

Compliance with remediation levels based on protecting human health will be evaluated during performance monitoring. The remediation level that is included in this category is:

- Groundwater will be treated to achieve the 477 µg/L total EPH/VPH level to protect groundwater to human health standards in the NE Developed Zone.

Compliance with this remediation level will be determined by direct monitoring of groundwater quality in monitoring wells. Due to the expense of EPH/VPH analysis, a correlation may be derived between NWTPH-Dx and EPH/VPH to allow groundwater compliance monitoring to use NWTPH-Dx.

### 10.5.3 Contingent Actions

Contingent actions are triggered when performance or confirmational monitoring indicates that a remedial alternative has failed to achieve performance standards, generally remediation or cleanup levels. The compliance monitoring plan will document procedures for determining when a contingent action is triggered and will specify the contingent action to be used to the extent possible. Some examples of possible contingent actions are provided below:

- **Levee** – The installation and operation of an enhanced bioremediation air sparging system should the groundwater cleanup level not be achieved due to excavation alone.
- **Former Maloney Creek Channel** – The implementation of an enhanced bioremediation system should hot spot removal not achieve the groundwater cleanup level and should the hydrogeologic assessment indicate potential discharges to the channel.
- **NE Developed Zone** – Enhancement of the bioremediation system using surfactants to make the petroleum compounds more biologically available should the cleanup level or the remediation level not be achieved.
- **NW Developed Zone** – The implementation of additional free product excavation activities should performance of confirmational monitoring demonstrate the presence of free product in a well.
- **NW Developed Zone** – The installation of vapor barriers or ventilation systems beneath building if air quality monitoring indicates that air quality exceeds human health criteria.

These concepts will be developed further and included in a compliance monitoring plan as part of the remedial design process.

## 10.6 Financial Assurance

BNSF's revised preferred alternative includes short-term capital and long-term cost operation, monitoring and maintenance requirements of various remedial systems. BNSF is confident that it has the financial resources needed to implement the revised preferred alternative. Ecology may choose to include specific "financial assurance" requirements in a consent decree with BNSF to implement a final remedy. The purpose of financial assurance is to ensure that sufficient financial resources are available to implement the final remedy. Following is the financial assurance required by MTCA:

WAC 173-340-440(11) Financial Assurances. The department shall, as appropriate, require financial assurance mechanisms at sites where the cleanup action selected includes engineered and/or institutional controls. It is presumed that financial assurance mechanisms will be required unless the PLP can demonstrate that sufficient financial resources are available and in place to provide for the long-term effectiveness of engineered and institutional controls adopted. Financial assurances shall be of sufficient amount to cover all costs associated with the operation and maintenance of the cleanup action, including institutional controls, compliance monitoring, and corrective measures.

(a) Mechanisms. Financial assurance mechanisms may include one or more of the following: A trust fund, a surety bond, a letter of credit, financial test, guarantee, standby trust fund, government bond rating test, government financial test, government guarantee, government fund, or financial assurance mechanisms required under another law (for example, requirements for solid waste landfills or treatment, storage, and disposal facilities) that meets the requirements of this section.

(b) Exemption from requirement. The department shall not require financial assurances if persons conducting the cleanup can demonstrate that requiring financial assurances will result in the PLPs for the site having insufficient funds to conduct the cleanup or being forced into bankruptcy or similar financial hardship.

BNSF currently provides financial assurances at various sites in Washington and other states. BNSF utilizes a “financial test” to provide financial assurance for cleanup costs at these sites. The annual test performed by BNSF takes into account all such liabilities consistent with EPA regulations in 40 CFR Part 264, Subpart H. The financial test requires BNSF to show on an annual basis three things: 1) Total Net Worth (TNW) is greater than seven times the cleanup costs for all sites where financial assurance is required; 2) TNW is greater than \$10 million; and 3) 90 percent of BNSF’s assets are located in the U.S. BNSF has consistently met all of these criteria for many years and adding the revised preferred alternative to the annual financial test will not cause BNSF to fail the test. A copy of BNSF’s 2004 financial assurance documentation for a site in Washington is attached as Appendix R as an example. Five Year Reviews for New Technology Developments

Under BNSF’s preferred alternative, TPH contamination will remain in soil and groundwater as non-recoverable NAPL. Excavation has been determined to be the most effective and practicable remedial technology for addressing the TPH impacts associated with the Site. Less intrusive *in situ* technologies

would be preferable to excavation with respect to having significantly less disruption to the Town. However, such technologies have not been found to be practicable at Skykomish at their current state of development and understanding. As a result, BNSF's preferred alternative includes areas of the Town and railyard that will be excavated, and others that will not be disrupted by excavation, but will contain these contaminants for a long-term future (likely to approach 100 years). Existing and/or new technologies may be further developed over this timeframe and could be effectively and practicably implemented in the future.

Five-year reviews of the project will be required as long as residual contamination remains above cleanup levels to ensure that the cleanup action continues to protect human health and the environment. In addition to reviewing successful implementation and progress of the selected remedial alternative in accordance with the Cleanup Action Plan/Design, these reviews will provide an opportunity to evaluate cleanup technology developments on an on-going basis. The five-year reviews will include an evaluation of technology developments that could be applicable to residual contamination at Skykomish. This evaluation will include an update on technologies that have been previously thought applicable to this site but not implementable due to their early stage of development. The evaluation will also include consideration of new technologies thought to have promise for use at Skykomish. These technology evaluations will be focused on contaminants that remain at the site – primarily non-recoverable NAPL, residual TPH in soil, and/or TPH dissolved in groundwater.

A technology would be considered for implementation if it met the following criteria:

- Significantly reduces restoration time frame – generally to less than five years, when there are otherwise anticipated to be several decades remaining without additional technology implementation.
- The technology will achieve a final cleanup level that allows for cessation of a current remedial technology (such as NAPL recovery trench operation) and/or removal of an institutional control (groundwater or soil use could become unrestricted).
- Sufficient data exists from other site applications to provide a high degree of confidence that the technology will be successful and to allow for substantial design of the technology implementation. Pilot testing may be part of the technology implementation – but this would be for site-specific design purposes and not technology development.
- Meets criteria of MTCA feasibility analysis including the substantial and disproportionate cost analysis.

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